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THE ECLIPSE IN CHINA

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Chinese history is romantic but difficult. The average Westerner soon gets confused by the endless succession of emperors and dynasties, with names hard to remember and even more difficult to pronounce. As a humble student, trying to absorb the contents of an "Outline of Chinese History" in order to satisfy the requirements of my Missionary Society, I can still remember with what glee I seized on the statement that in 2159 B.C. the emperor Chung K'ang executed the astronomers Hi and Ho for failing to predict an eclipse of the sun. The uniqueness of such an event provided at least one landmark and a few names that I *could* remember!

But such an incident is not only of interest to the student of Chinese History on the lookout for an easy date. The historian and the astronomer would naturally be overjoyed at such a good piece of material from the hoary past on which to work. What a splendid chance for the astronomer to verify this eclipse and then proceed to use these data to check up our values for the acceleration of the moon's motion! And then the historian could use the verified date for fixing remote periods in human history.

The execution of the unfortunate Astronomers Royal for failing to predict the eclipse would appear to justify the assumption that the Chinese were in the habit of predicting eclipses more than 4,000 years ago. But this is not the only astronomical marvel of the Golden Age of Chinese History. We can go even farther back, to the time of the famous emperor Shun, about 2300 B.C., who feared that his astronomers Hi and Ho, (probably the ancestors of the Hi and Ho of eclipse fame), were neglecting their duties (it must have been a family failing)! He thereupon commanded them to construct a figure showing the dome of the sky divided into degrees, with the earth in the center and the sun, moon, planets, and stars in their proper positions and giving the movements observed. Precious colored stones marked the poles, sun, moon, and planets, while pearls were used to indicate the stars. The emperor was apparently satisfied with this working model, and we can only infer that the famous Adler Planetarium at Chicago is about 4,200 years behind the times!

A study of Chinese Astronomy inevitably leads one back to the famous 2159 B.C. eclipse. It is an event which, in the words of the famous historian Cordier *"a fait couler beaucoup d'encre."* The controversy is

not yet settled and it is encouraging to know that modern trained Chinese scholars are engaged in a critical study of the whole question of Chinese Astronomy. Their knowledge of the ancient Chinese classical writings concerned, (which require a lifetime of study for the Westerner), together with their modern scientific training, should prove very fruitful of results in clearing up many of the uncertainties in this field.

It would seem that the main difficulty is the question of the authenticity of the existing text of the "Shu King," one of the Five Canonical Books of the First Order; this "Book of History" covers the period from the time of the legendary emperors Yao and Shun (circa 2300 B.C.) down to the date 721 B.C. in the Chou Dynasty. The original Book of History was edited by the great sage Confucius who lived around 500 B.C.; he selected what he considered of value from a mass of historical records and traditions covering the above-mentioned 1600 years. It thus gives us first hand accounts of the state of early Chinese civilization, but it must be remembered that these were transmitted by the great Sage not as a strictly historical work but rather as a manual of political science. Recent scholarship therefore, recommends that the Shu King be used with great caution.

The Chou Dynasty came to an end in 255 B.C. The first emperor of the new dynasty, the Ch'in, is best known to us as the builder of one of the seven wonders of the world, the Great Wall of China. To the Chinese he is best remembered as the infamous Ch'in Shi Huang Ti, who had conquered the whole of China, and had proclaimed himself "The First Emperor." He was to be the Superman, from whom all history was to begin, and so he gave an order for the burning of all books, especially those which were historical works. We are told that he himself examined daily one hundred pounds by weight of books, and cast into the flames all works other than those dealing with the utilitarian subjects of Medicine, Agriculture, and Astrology. The "Book of History," reaching back through the centuries to an age two thousand years before his time, must have been particular anathema to our self-styled "First Emperor," and, so far as we know, not one complete edition escaped the flames.

Within twenty-five years another emperor was ordering the restoration of the destroyed works. But the only copy of the Shu King which could be found was an incomplete one which had been walled up by a devoted scholar. This consisted of only 28 or 29 out of the original 100 chapters, but there was no mention of the eclipse in this authentic copy. Another account says that an old scholar named Fu Cheng remembered by heart these 29 chapters and recited them to the authorities who were endeavoring to recover the ancient texts. It was about 75 years after the burning of the books that a descendant of Confucius discovered a version in archaic script of 16 more sections of the Shu King. These he edited and then they appear to have been again lost for about 450 years, until, in 320 A.D., they were put together out of fragmentary

quotations and similar material and presented to the emperor Yuan-ti. In the preface to one of these sections in the archaic script we read as follows: "Hsi and Ho, sunk in wine and excess, neglected the ordering of the seasons, and allowed the days to get into confusion. The prince of Yin went to punish them." This preface is followed by an account of the Punitive Expedition of Yin.

But there are other references to this famous eclipse. Some two centuries before the burning of the books we have the comments of a scholar named Tso, who in his "Commentary on Annals of State of Lu," wrote concerning the lost work (The Punitive Expedition of Yin), "The sun and moon did not meet harmoniously in Fang. The blind beat their drums; the inferior officers and the common people ran about."

A third reference is to be found in "The Annals of the Bamboo Books," which fortunately escaped the flames. These annals were written in the third century B.C., and in them we read as follows: "In his fifth year, in the autumn, in the ninth month, in the day kang sui, (47th of cycle), which was the first day of the month, there was an eclipse of the sun, when he ordered the prince of Yin to lead the Imperial forces to punish Hsi and Ho." This is the only account in which the Emperor's name is mentioned, but even though some authorities doubt the authenticity of these Bamboo Books, the placing of the eclipse in the reign of Chung K'ang is generally accepted both by unanimous Chinese tradition and by the celebrated historian Ssu Ma-chien.

The Bamboo Books give the date as Oct. 28, 1948 B.C., but there was no eclipse that day, not even a new moon. This would give point to Ssu Ma-chien's refusal to trace Chinese chronology farther back than 841 B.C. Beyond that date we know nothing beyond the names of the emperors and their relationships, and all we can say is that Chung K'ang reigned somewhere around 2000 B.C.

We have now disposed of the references to the eclipse in the ancient literature of China. We shall now see what some of the astronomers of both East and West have been able to do with these slender and ambiguous data.

In the Tang Dynasty (618 to 907 A.D.) Chinese astronomers attempted to fix the date by computation and placed it at 2155 B.C. But this was computed in ignorance of secular acceleration and the astronomer Largeteau has shown that the eclipse of that date was not visible in China.

At the time of Kublai Khan in the thirteenth century the astronomer Kuo Shou-ching computed the date to be 2128 B.C. Unfortunately, however, his methods did not prevent him from making two faulty predictions of solar eclipses himself!

Of the many European astronomers who have worked on the date of this eclipse, we may mention Oppolzer, who gives Oct. 22, 2137 B.C., and Schlegel with his two dates, May 7, 2165 or May 12, 1905 B.C. Fotheringham in his Halley Lecture at the University of Oxford con-

cluded that the evidence does not permit the identification of this eclipse. In fact, modern critics in the West are inclined to believe that Hsi and Ho were rebels and that the Prince of Yin was sent to punish them because of their known sympathies with the rebel faction of that time. It was not a question of failure to predict the eclipse; it was their failure in watching the sky and in not announcing the first contact of the moon's disc and so warning the populace to drive off the heavenly dragon from its meal. Apparently the eclipse caused considerable terror and confusion among the people, and this served as an excuse for the Emperor's punitive expedition. And the Higher Critics even go so far as to doubt the untimely end of the bucolic governors; they assert that the two astronomers took an active part in the rebellion that ensued and that they were hale and hearty some years subsequent to the eclipse!

In the Chinese records no solar eclipses are mentioned between 2159 and 776 B.C. Someone has suggested that this is because the fate of Hsi and Ho discouraged the scholars and the intelligentsia from taking an active interest in the science of Astronomy! The Burning of the Books probably explains this gap of nearly 1400 years, though one recent authority says that the astronomical works were not destroyed. There is a possibility that they were not, since astronomy in those remote times was the handmaid of agriculture and therefore may have been ranked as one of the utilitarian sciences spared by the "First Emperor." On the other hand astronomy was also the servant of the royal house, and was often called upon to work violent changes in the calendar, depending upon celestial events. We are told that in 2513 B.C. the five planets were in conjunction on the same day that the sun and moon were in conjunction, and therefore the Emperor declared that day to be the first of his calendar. From the seventh to the fifth centuries B.C., these dynastic calendars, with the commencement of the royal year still traditionally called the spring, were very confusing to the farmers, because the first day of "Spring" might fall anywhere between November and February, depending upon the number of intercalary months employed. It may have well been therefore that the Superman considered Court Astronomy more historical than useful!

It is possible also that far too much emphasis is laid on the Burning of the Books as an explanation for the loss of all astronomical literature. As a matter of fact the "Superman" only destroyed all private collections. He apparently had a private library. But history now seems to point to the great conflagration at the capital city of Shien-yang, when the short-lived Ch'in dynasty was overthrown. The fires burned for three months and effectively disposed of the royal library and any books which had been hidden inside the city. It must be remembered too, that on three subsequent occasions there have been literary catastrophes causing wholesale losses to Chinese literature.

From 776 B.C. on we have a large number of eclipses by means of which astronomers can confirm Chinese chronology. In that year the

"Shih King," the "Book of Poetry," records an eclipse of the sun preceded by an eclipse of the moon. The exact date of the solar eclipse is given and has been verified astronomically. Then, in the "Spring and Autumn Classic" written by Confucius, in a brief summary of the chief events that took place in the State of Lu between 722 and 481 B.C., there are records of 36 eclipses, 32 of which have been identified. It has been suggested that the other four were entered as eclipses because of some curious phenomenon seen near the sun, and the astronomers were not taking any chances! In short, from 776 B.C. to 1433 A.D. solar eclipses are mentioned every few years in various Chinese records. Then comes a blank of 200 years, when a few other notices terminate the catalog. It is interesting to note that very few eclipses of the moon are recorded, and also that whereas the Chaldeans gave details of their solar and lunar eclipses, the Chinese gave only the date.

We may doubt if the early astronomers were keen loyalists. It was supposed that there was a natural connection between actions of princes and celestial phenomena. Good or false actions of princes could change the movements of the stars. This false notion was particularly true of eclipses. In the third century A.D. Chinese astronomers said that in ancient times there were no eclipses, and that it was only the actions of bad rulers that had put them under the irksome necessity of predicting them! Astronomers of later dynasties have stated that it was not until the third century A.D. that there were fixed principles for calculating eclipses. But even in the eighth century we have as celebrated an astronomer as I-Hang triumphantly announcing two eclipses which failed to occur. He affirmed that his calculations were exact and said "It is the fault of the stars, which have changed their motions." His failures, together with the subsequent predictions of other astronomers which failed to come to pass, served a very useful purpose when in 1299 the Tribunal of Mathematics announced a "two-finger" eclipse, which did not occur. People trembled for the fate of the members of the Tribunal, but they justified themselves by citing ten similar failures since the year 713!

The latter part of the thirteenth century has been referred to as the Golden Age of Chinese Astronomy, with its central figure, Kuo Shou-ching as the Chinese Tycho. Unfortunately, his valiant efforts to revive the science had little effect, for his death was followed by a period of inactivity lasting for more than three centuries. In 1573 Prince Tching tried to restore the science. Together with an astronomer named Hing he explained a method of predicting eclipses and calculated back to all eclipses mentioned in Chinese Annals, but even this work failed to bring the nation out of its indifference to Astronomy.

This brings us to the early part of the seventeenth century, when the calculated solar eclipse did not accord with the actual observations. The Assessor of the Tribunal of Mathematics proposed for membership the Jesuit missionary priests Longobardi and Terence. This could not be

done, however, without an order from the Emperor, whose sanction was necessary for any changes in the science of astronomy. This gave the anti-foreign element a chance to press the claims of the native science and to urge the abolition of the European astronomy practised by the missionaries. The Emperor settled the matter by summoning all the astronomers to his court and asking the Chinese to propose some test which would establish the superiority of their school. They did not know what to suggest, whereon Father Verbiest proposed that each school should calculate the length of the meridian shadows for gnomons of various lengths on the following day. The Emperor agreed to this suggestion, but to his dismay found that his own astronomers did not know how to calculate these lengths.

With Ferdinand Verbiest as Imperial Astronomer Chinese Astronomy was brought up to date and we hear no more of solar eclipses which did not agree with the predicted date and hour. It was only in the method of observing the eclipse that China now differed from the nations of the West. Delambre in his "Histoire de l'Astronomie Ancienne" tells us that the observation of eclipses was one of the first and most important functions of the Tribunal of Mathematics. It was their duty to inform the emperor several months beforehand of the exact date, time, and the part of the sky in which the eclipse would occur. These data had to be calculated for each provincial capital in the vast Chinese Empire. The Board of Rites and Ceremonies then became responsible for passing on this information to every city and had to see that the celestial event was observed according to the exact rites prescribed therefor. Several days prior to the eclipse, proclamations in large characters would be put up in public places and at the city gates, giving the hour of commencement, position in sky, duration, and time of ending. In the capital itself, mandarins of all ranks assembled at the Court of the Tribunal of Mathematics to await the eclipse. In their hands they carried papers on which were written the details of the approaching event. At the first contact of the moon with the sun's disc, all had to fall on the ground and kowtow, *i.e.* to touch the ground with the forehead. Meanwhile in each city as contact occurred the common people frantically beat drums and gongs to scare off the heavenly dragon as it devours the sun. By this time the various astronomers would have assembled at their observatories to note down the time of commencement and ending of the eclipse for comparison with their own predictions; then, making the necessary corrections, the various documents would be stamped with their personal and official seals and dispatched to the emperor. But since the overthrow of the Son of Heaven in 1911, republican China has been gradually discarding much of the pageantry and romance of her old customs, and never again shall we see a Chinese gunboat, armed with Krupp guns, turning out her crew, by order of the "Peking Gazette," to make a din with drums and bugles and gongs to save the moon from the dragon of the sky, at an eclipse of the moon.

The present Nationalist Government at Nanking, at the same time that it is trying to hold the nation on a middle course between the Scylla of Militarism and the Charybdis of Communism, is also endeavoring to modernize every sphere of the national life. It hails Western science as a powerful ally, so that we may confidently expect that the future will see the study of both their own ancient astronomy and that of modern times pursued with the enthusiasm and vigor which is so characteristic of the Young China of today.

OCTOBER, 1930.

ON A GREAT METEOR SHOWER OF THE YEAR 524 A.D., AND ITS PROBABLE CONNECTION WITH THE COMET OF BIELA AND WITH THAT OF THE YEAR 1162

By W. KLINKERFUES.*

Note by the Translator. The following brief paper was published in an academic periodical of very limited circulation, and seems to have escaped the notice of students of meteoric astronomy. The title, found in Houzeau's *Bibliography of Astronomy*, hardly suggests its importance. This paper extends backward the history of Biela's comet and of the Andromede meteors to 524 A.D., which far antedates the first known apparition of the Leonids (902 A.D.), and is earlier by over 1200 years than the year 1741, the first Andromede date otherwise recognized. It also suggests an interesting method for discovering the identity of observed unknown comets or cometary meteor showers.

The incentive to the investigations here communicated came from Professor Unger, when, on February 8 of this year, he wrote me the following note:

"(*Theophanes chronographia* ad a. 524, p. 286, of the Bonn edition of the *Scriptt. hist. Byzant.*) In this year (524 after the birth of Christ), though, there occurred also much running of the stars

(ἀστέρων δρόμος πολύς)

from evening quite to daybreak, so that everybody was frightened, and we know of no such event beside."

"Of the same thing there is a similar statement" (continues Professor Unger) "if I remember correctly, in the *Chronicon paschale*. I do not know whether these references have yet been noted. They seem to me to refer to an event similar to the one we lately experienced." [Bielid meteor shower, 1872 Nov. 27.—The date 524 A.D. is not mentioned in the meteor list of Quetelet, *Physique du Globe*, 1861.]

That here the reference was to an extraordinarily brilliant meteor shower could hardly be doubted, as other reports of the phenomenon speak as of something quite extraordinary. So I was again tempted to ascribe the unusually rich meteor shower to the unusually near approach

*Translated by Willard J. Fisher from *Göttinger Nachrichten*, 1873 April 30, pp. 275-296. [ ] indicate insertions by the translator.

of some comet, especially as in October of the same year a comet was seen. While in fact there are no observations of the comet of 524, as, equally, no determination of the radiation point of the meteors, yet a sort of test of the hypothesis seemed not impossible, if only something could be learned about the season of the meteor shower. My request was met by a second note from Professor Unger, in which he gave me this:

"Michael Glycas, *Annal. Pars* 4, p. 500, of the Bonn edition: For twenty days also there appeared a comet, and after some time there occurred a running of the stars from evening till early [morning], so that people said all the stars were falling."

Some time in such a connection probably denotes *some days*, or a *few weeks*, and with regard to the fact that the comet was seen for several weeks in October, it points to a shooting star shower quite at the end of October or in the first weeks of November. At first one could therefore believe, that there was a remarkable apparition of the well-known Leonid shower, with radiant point near Gamma Leonis, until convinced that this, in the sixth century, must have occurred in the beginning of October, and also that it has always divided the centuries quite accurately into thirds. But this case fits naturally into another series of ancient, remarkable meteor showers, which we find mixed with others in Klein's *Handbuch der allgemeinen Himmelsbeschreibung*, Part I, p. 328. These are, using the dates reduced to New Style:

585 A. D., November 12
837 November 12 (observed in China).
899 November 18 (observed in Egypt).

In the next centuries I fail to find sufficiently reliable references. In searching for a continuation of the series, we may not forget, that because of the difference between the tropical and the sidereal years, caused by the precession of the equinoxes, epochs come later about 1.4 days in a century. Toward the end of the eighth century, according to the numbers above, the mean date of the shower (*i.e.* the adjusted date, freed of the influence of perturbations and irregularities) fell about November 14,N.S.; about the end of the sixteenth century, we have to look for a date about November 25. Taking note of the very obvious period of about 62.6 years, we recognize a continuation of the above series in the cases of 1584 November 28 and 1586 November 25. Finally, we note as belonging here the case of 1838 December 6 to 8. This last again belongs to a series first (to my knowledge) pointed out by D'Arrest, *A.N.* No. 1633, and which no doubt is properly brought into connection with Biela's comet. This contains the meteor showers of

1741 Dec. 5 observed by Krafft in St. Petersburg;
1798 Dec. 6 Brandes observed 2000 meteors at Bremen;
1830 Dec. 7 observed by Raillard; *C.R.* 7, p. 177;
1838 Dec. 6 Flaugergues at Toulon;

1838 Dec. 7 Edw. Herrick at New Haven, "from a point in the sky near the chair of Cassiopeia."

The last statement agrees with Heis' radiant 21° +54°.

Here I make certain preliminary remarks about the results of computations to follow. Attaching myself to the opinion of Professor Weiss, that the last splitting of Biela's comet, in December, 1845, was not the only one, I consider it necessary in the study of ancient star showers to separate an ancient and a modern Biela comet, and so also to separate the two radiants in Andromeda and Cassiopeia, which have been noted at the end of November and the beginning of December. The orbit of the modern Biela comet before 1838 had been such that to it the radiant in Andromeda 25° +40° (Heis' determination of 1847) or 26° +37° (according to my recent determination, which led to the discovery of the meteor swarm of 1872 November 27, in Madras) corresponds very much better in regard to time and everything else. Considering this and other things, there seems reason enough to devote special investigation to the radiant of 1838 December 7 and the series which plainly enough goes with it. This will lead us along a path, as little arbitrary as possible, to a comet different from the well-known comet of Biela.

A glance at the data collected above shows that the meteor showers of the years 524, 585, 837, 899, 1584-1586 and with them 1838 fit a period of 62.6 years with satisfactory accuracy. Regarding the modern series, in which the less striking cases have also drawn attention (while the older accounts generally mention only such events as stirred astonishment and general interest), one is led to the assumption, that this period of 62.6 years is a multiple of the real period, and, in fact, with a multiplier 9. Why the multiplier 9 plays here such an important part, will appear from the later course of this study. Assuming a period of 6.947, and the formula

$$I = 524.4 + 6.947\, n$$

in which I, rounded off to an integral, denotes the year number of the epoch, and n the number of periods elapsed since the year 524, we are led to the following dates, to be compared with the [observational] material.

524 A.D.	899 A.D.	1796 A.D.
586	1587	1830
837	1740	1837

The differences between these and the dates actually observed do not surpass the permissible, for the number 6.947 for the period is only a mean, which suffers perturbations of long duration; for short intervals the periods become

from	524	to 585,	6.778
	585	837,	7.000
	837	899,	6.889
	899	1585,	6.921
	1585	1741,	7.091
	1741	1838,	6.929

The form of the orbits of comets and meteors favors the production of large perturbation terms of long periods, since the perturbation function imagined as developed will have even for terms of very high orders coefficients still considerable, and especially for those whose indices are very closely in the ratio of the periods of the disturbed and disturbing bodies. We may therefore not expect to find the motion of the line of nodes to be in agreement with its secular perturbation. For example; for the famous Leonid stream, or comet 1866 I, which has retrograde motion in the orbit, and consequently must have direct secular motion of the line of nodes (2100″ according to Adams), a direct motion of the line of nodes of 5240″ per century is observed. The meteor swarm now under investigation, easily recognized as having direct motion in its orbit, should therefore, judged merely by the calculable secular perturbations, have a *retrograde* motion of the line of nodes, opposite in effect to the precession. Instead there is actually a direct motion annually of almost 16″.4, and on the average the meteor shower occurs every century 1.88 days later, as shown by the result of an adjustment.

I now collect the epochs of the meteor showers by year and day, as they would have occurred according to the proposed hypothesis, but for perturbations and other irregularities, and with them the epochs of the actual observations:

Computed	Observed	Computed	Observed
524 Nov. 9	524 Nov. ?	1740 Dec. 3	1741 Dec. 5
586 Nov. 10	585 Nov. 12	1796 Dec. 4	1798 Dec. 6
837 Nov. 15	837 Nov. 12	1830 Dec. 5	1830 Dec. 7
899 Nov. 16	899 Nov. 18	1837 Dec. 5	1838 Dec. 7
1587 Nov. 30	{ 1584 Nov. 28 { 1586 Nov. 25		

The difference of two days in dates, constant during the last century, is probably due to a long enduring perturbation. In computing the orbit of the meteor swarm, the adjusted date is to be preferred to the observed, for in this connection the recent observations are not superior to the others of the series. I now compute the orbit of the meteor swarm or of the corresponding comet from the radiant 21° + 54° (or longitude 43° 12′, latitude +41° 10′), as if the meteor shower had occurred 1838 Dec. 5, 8:00 P.M. This seems to me to follow from the adjustment of the date, but otherwise to be of little importance. These data lead to the following elements:

Perihelion 1838 Dec. 24.508 Berlin Time

$\Omega = 352° 16'$
$i = 16\ 53$
$\pi = 99\ 46$
} Equinox of 1838.0

$e = 0.74157$
$\log a = 0.56120$
$U = 6.947$
$\log q = 9.97354$

On account of their derivation from the most highly probably related meteor showers of ancient and modern times, these elements have the

best claim to be considered the elements of the old, perhaps even still undivided, Biela comet; as they also betray almost equally great similarity to the elements of its two probable fragments, to Pogson's elements of comet 1818 I and to those of the well-known Biela comet. For convenient comparison I give these elements, referred to the equinoxes of 1818.0 and 1832.0.

Comet 1818 I	Biela's Comet
$\Omega = 250° 04'$	$\Omega = 248° 14'$
$i = 20\ 02$	$i = 13\ 10$
$\pi = 97\ 07$	$\pi = 108\ 53$
$\log q = 9.86526$	$\log q = 9.94516$
	$e = 0.75138$
	$U = 6.652$ years

The above orbit of the old Biela comet has the peculiarity of an unusually close approach to Jupiter's orbit, which helps to elucidate the unique place which the Biela segments hold among the comets. In fact, if the true anomaly of the comet is 158° 13′, and that of the planet is 246° 01′, their mutual distance is 0.089, only three and a third times as large as the distance of its fourth satellite from Jupiter. At present I know of no other so close approach of any cometary orbit to that of Jupiter, except that of the famous comet 1770 I.

With the consequent great perturbations by Jupiter seems to be connected the fact, that the older and certainly most remarkable meteor showers recur only at intervals of 62.6 years or an integral multiple of the same; for it is unreasonable to assume that the weather was accidentally favorable only at such intervals. At least approximately, nine revolutions of the comet are equal to five of Jupiter. Further, it must not be forgotten here that the period 6.947, found above, can only represent a mean, which is subject to notable variations, due also in no small degree to the earth.

The comet apparition of 524 A.D., which people at the time so curiously connected with the extraordinarily brilliant meteor shower coming a few days or weeks later, wakes the hope of finding among ancient comet apparitions some of Biela's comet. Judging from probabilities, among 365/2 returns of the comet, on the average there would be one at which the earth and the comet would pass the node of their orbits within twenty-four hours of one another, *i.e.* when the conditions of visibility could be so favorable that even the much weakened Biela comet of our days should be easily perceptible to the naked eye. Among the reports on ancient comet apparitions, which cover a much greater length of time than 183 [Biela] periods, the Chinese reports, as is well known, are distinguished for their reliability, both with regard to dates and to celestial positions. On the above comet of 524 A.D., unfortunately, no such report exists; consequently we cannot by comparing dates settle the question, whether the meteor shower in question was different from one of the Leonids. If that comet was really Biela's (which I do not believe, because it was visible so long), then Pingré's *Cométographie*

should yield us much in this connection, among the comet apparitions of October, November, and December.

With regard, however, to the later apparitions, for the most part all position data are lacking for further investigation, whence we must be limited to a small selection of more remarkable phenomena. Even with greater brilliancy in former times, Biela's comet could probably only have appeared to the eye when it passed the line of its descending node a very few days before or after the earth; above we have seen that within the period investigated we have a chance for at least one such apparition. This being the case, we can diminish the labor uncommonly by setting up certain criteria easily and certainly applied. By the peculiarities of the geocentric path now to be developed we will not only be freed from computing the time of perihelion for each apparition, or at least of testing whether with a given direction of observation a determined point of the orbital plane is also a point of the cometary ellipse; rather, we are in a position to recognize the meaning of the observations almost without computing, and to state the probability of the identity of an observed comet with Biela's. The usefulness of the following considerations is not, however, limited to this concrete example; but presents itself especially when a meteor shower of importance gives reason for seeking on the celestial sphere the [meteoric] objects now collected into a comet-like form. It will be shown, how we can increase the chances of success so greatly, that in the future even somewhat less rich showers, which indicate merely the neighborhood of a strong condensation, can be taken into the domain of such investigations.*

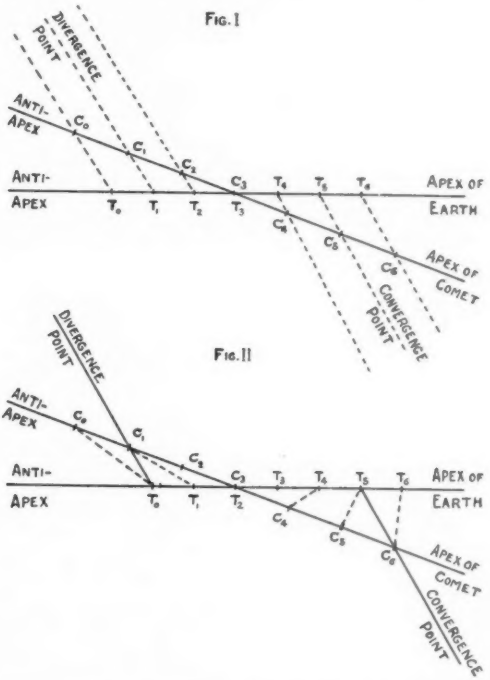
The parts of the orbits of comet and earth, here intersecting, can for a few days be regarded as [infinitesimal] elements, straight and traversed with constant velocities. We have then to distinguish the three following cases; either the earth goes through the node simultaneously with the comet, or before, or after. Figure I represents the first case, in which corresponding positions of the earth and the comet on the two orbit segments C_0C_6 and T_0T_6 are indicated with like figures.

The connecting lines C_0T_0, C_1T_1, C_2T_2, point toward the radiation point of divergence, the lines T_4C_4, T_5C_5, T_6C_6 toward the convergence point; all these directions are obviously parallel, and we therefore see

*Just on January 2 of this year [1873] opportunity for such a course would have been offered. For Freiherr von Bönigk, on the morning of this day, (astronomical time Jan. 1, 18^h M.T.) was returning here in a carriage from Schloss Burlepsch, and was surprised by a meteor shower, which he represented to me as hardly second in brilliancy to that of Nov. 27 last year, and in which the meteors seemed to come from the low southwest or west. Hence probably Neumayer's radiant $105^d - 27°$ in the Great Dog was playing with unusual strength. I did not receive this communication till eight days later; yet by New Year's Eve I had been informed by the Castellan Heidorn of the extraordinary brightness of the celestial vault. Such a brightness of the sky before, during, or after a rich meteor shower has been so often noted, that after this last experience I shall always regard this phenomenon as a warning to be on the lookout for a meteor shower; and especially at those times of the year which are especially notable for star showers; as Jan. 2, Apr. 20, etc.

that, before the meeting with the earth at $C_3$and T_3, the comet is stationary in the radiation point of divergence, afterwards, stationary in the convergence point. Further, these connecting lines lie with C_0C_6 and T_0T_6 in a plane, consequently both radiation points lie on a great circle, which also passes through the apices of the motions of comet and earth at this point.

Figure II represents the case in which the earth reaches the node before the comet. The position of the connecting lines T_0C_0, T_1C_1, etc., shows that here, unlike the preceding case, the whole geocentric motion



from divergence point to convergence point is not made in one jump, but gradually, and in such a way that the geocentric position first falls in the arc of a great circle between the divergence point and the earth's antiapex. During the passage of the earth through the node T_2, *i.e.* according to Schiaparelli's theory, during the meteor shower, the comet or meteor swarm would appear in the counter point of the direction of its element, which we will call an antiapex. With favorable position and time of day, the comet would also be observed in the same point, together with the meteor shower. Continually progressing in the same great circle, which passes through the radiation point, the apex and the

antiapex of the earth's motion, the geocentric position at the last named point crosses the ecliptic, and then, at last, as it were asymptotically, approaches the convergence point until the errors of our assumptions become sensible.

The third case, in which the earth passes the node after the comet, differs from the preceding in this, that the geocentric position moves in the same great circle from the convergence point in the opposite direction, that is, crosses the ecliptic at the earth's apex, then its own apex (when, under favorable conditions, a meteor shower is observable), and thence goes slower and slower to the convergence point.

The error of the assumption, that the orbits of earth and comet do intersect, while really there is a very small minimal distance apart, expresses itself in deviations from the above described geocentric course. These deviations are of the order of the ratio

(minimal separation of the orbits)/(distance from the earth).

The minimal separation we regard as a second order quantity, the distance from the earth however, in general, as of the order of the path segments traversed, consequently of the first order. The deviations of the motions in the great circle are in general small quantities of the first order, and can become of zero order only if the distance becomes of second order.

If in these considerations I have been somewhat diffuse, I think that excusable on account of the practically not unimportant consequences. That we should get into almost immediate contact with a comet or the corresponding meteor swarm, so that a search near the convergence point would have immediate success, would not probably happen very often. Much more frequently can the case occur, that in a meteor shower of above average brilliancy we meet the skirmishers or stragglers of a group such that even when concentrated at the convergence point they reflect not enough sunlight to be visible. Yet a perceptible object could nevertheless be found, if search were extended to regions along that great circle which connects the radiation point with a point on the ecliptic about 90° from the sun. If we have a definite suspicion about the orbit—as commonly is the case in this kind of research—it is useful to remember this, that during a meteor shower the comet itself is to be sought at either its apex or its antiapex. The comet goes through the apex or through the antiapex, but never through both these points, and one cannot know in advance, through which the way is taken. Likewise the comet for some time after the meteor shower nears the convergence point, only we cannot know from which side in the great circle this is to happen. By telegraphic appeals for searches of this sort in the future it could obviously be brought about that search would be made perhaps on both sides of the convergence point, for the object must ultimately enter this region. Whether it will be bright enough we can only learn through success of the search.

I now return to the attempt to discover an ancient apparition of Biela's comet, and for the purpose shall introduce the criteria, which, if they are on the whole applicable, allow us to assert that the phenomenon in question really belongs to the comet, or that chance has operated in a degree highly unlikely. According to the preceding we must have

(1) The geocentric course is in a great circle through the radiant; and, independent of this,

(2) The motion strikes the ecliptic in a point 90° from the sun;

(3) The sense of the motion is from the divergence point toward the convergence point;

(4) At the time of the observation the earth is really very close to the node;

(5) The comet also could be near the node, *i.e.* the year could have covered a return of the comet.

In the present case criterion (5) has no value, with a revolution period of seven years, for the maximum of a possible deviation from the mean epoch cannot amount to 3½ years.

On the contrary, criteria (1) and (2), or either alone, will not easily be fulfilled by mere chance, and by far less so can their combination.

Obviously, too, criterion (4) is of great importance. For both (1) and (2) can be fulfilled, but at a season when the earth is far from the node; and it is highly improbable that chance would pick out, among all the days of a year, those few which alone here amount to anything.

(1) and (2) in combination can be treated as one criterion, that the pole of the geocentric path must coincide with the pole of the great circle which goes through the radiant and intersects the ecliptic in longitude $90° + \delta$. If the mutual distance of these two poles, due to probable error of observation, is found equal to ϵ, then the probability that this error arises by chance is equal to the quotient, surface of a spherical segment of altitude $1 - \cos \epsilon$, divided by the total spherical surface, *i.e.* $2 \sin^2 \frac{1}{2}\epsilon$.

But the probability that, simultaneously with this, the motion in the same great circle by chance alone is from the divergence point to the convergence point, and not the reverse, reduces to half of this expression, or $\sin^2 \frac{1}{2}\epsilon$.

The probability that a comet by chance alone passes the ecliptic only n days before or after the earth passes the node is equal to $2n/365.25$; the probability, that a comet fulfilling all the above conditions within an error ϵ is the desired one, is

$$w\,(1 - [2\,n \sin^2 \tfrac{1}{2}\epsilon]/365.25)\,;$$

in which the factor w represents the probability that, according to the nature of the observations, an error of magnitude at most ϵ can occur at all. The probability that the observed comet is the one sought is zero, if the error ϵ appears impossible.

On these principles, let us investigate the probability that the comet

observed in China during the year 1162 A.D. was the old Biela comet. In Pingré's *Cométographie* the record reads:

On the day Vou-tchin, tenth month (Nov. 13) there was seen in China a great star between the constellations Che (α, β Pegasi) and Toung-pi (γ Pegasi, α Andromedae); it went as far as the stars Yu-lin (between Aquarius and Cetus, south of the ecliptic). The length of its tail exceeded ten degrees.

The date is Old Style, hence Nov. 20 of the New, to which I have above reduced all dates. The stars Yu-lin are the group at χ and ψ Aquarii. According to our nomenclature the geocentric path went from longitude 352°, latitude north 21°, to 334° and south 3°.

At that time the descending node of the Biela comet, according to the calculations above, must have been passed by the earth on Nov. 21, N.S., when $\odot = \Omega = 239°$. The earth's antiapex has longitude 329°, or, better, 330°; the longitude of the radiant in Cassiopeia, at that time, was 34°, its latitude +41°. The pole of the great circle, in which the geocentric motion must fall, consequently had longitude 240°, latitude +46°, and the pole of the observed geocentric motion, longitude 246°, latitude +35°.5. The mutual distance of these poles, ϵ, is consequently 11°.5. This discrepancy is plainly possible; for the purpose of an estimate, let us consider it as that error, which is as often reached as exceeded, for which consequently the probability for a single observation is ½, and consequently again the probability of its occurrence at all becomes certainty, or 1.* It is just as probable that greater accuracy in observation would increase it, as decrease it.

We have now to estimate n. The Chinese observations, which Pingré copied from Goubil's manuscript, generally follow the praiseworthy custom, for a second or third position also to give the second or third date, in case the time interval too has some importance. At least the duration of the phenomenon is noted, if it is at all long. In the above reference the apparition of the comet of 1162 is handled almost as if only a single date were concerned, which indicates a visibility of very short duration. The suspicion seems to me not entirely ungrounded, that the comet was first seen at the antiapex of its path about 5:00 or 6:00 P.M., Nov. 20, with the above estimated longitude; that during the following forenoon the earth went through the line of nodes and through the meteor swarm, during which time the comet had passed the antiapex (then in about latitude north 16°), and that on the evening of the 21st the comet had already reached the ecliptic. This very plausible assumption would correspond to $n < 1$. Instead of this let me assume $n = 7$, very unfavorable to my hypothesis; for it cannot be assumed in fact that the report would not then mention a second date, perhaps that of the last visibility.

With this value of n the probability of the identity of the comet of

*To avoid the appearance of a logical circle, we can reason thus: If there are no instrumental grounds for limiting the error, then the probability of the identity, which comes on other grounds, is alone determinative.

1162 with the old Biela comet equals 2598/2599; *i.e.* in 2599 cases of equally good coincidence, the apparition investigated would only once be different from Biela's comet. In the reference, the designation *"great star"* is applied to the comet. According to the customary use of words, that can mean *bright* or also *big*, *i.e.* of considerable diameter. If we ascribe to Biela's comet a diameter of 5000 geographical miles [=3.71 $\times$ 10^7 km], then, at a distance of 500,000 miles [= 3.71 $\times$ 10^6 km] it could reach the apparent diameter of the moon's disk; so that the designation *great* would seem in the true sense of the words, very suitable. With similar distance Biela's comet could even now appear as a star of 3d to 4th magnitude with a noticeable tail.

Professors Waitz and Wüstenfeld were so kind as to give me other references from ancient sources. But there was no more to be found in these than elsewhere in Pingré, about Biela's comet, capable of being treated as above. But there were other very interesting references, among them one about a maximum of the April meteor shower, which promises to further greatly our knowledge about this shower and its parent, comet 1861 I.

GÖTTINGEN, MARCH 1, 1873.

THE LOCATION OF PLANET *P*
(Continued)

By WILLIAM H. PICKERING.

The location of this object must now be about as accurately known as was that of Pluto before its discovery, for while its longitude is more uncertain, and we cannot expect to locate it as in that other case within a degree, yet we know its angular distance north or south of its computed orbit with much greater certainty,—probably within 2°. Our uncertainty as to the longitude is caused by its great distance, which renders the amount of the correcting angle a little uncertain. But since the possible range of this angle is only a few degrees, and a range of even 15° is now quickly covered by means of photography, we see that it should be no serious undertaking to find it. The fact that it is fairly bright, of about magnitude 11, should materially aid us in our search. I am informed indeed that some southern observers have already interested themselves in the matter, and in case their search is unsuccessful they have themselves volunteered to report the area actually examined by them, together with the magnitude of the faintest stars shown upon their plates. Should any others undertake the search I trust that for the *general good* they will do the same thing, and not keep their results to themselves. The importance of this precept as we all know, was rather strikingly illustrated in the case of Pluto, where our knowledge of the very existence of the planet was probably delayed for ten years,

by the failure to inform the computer that a search had been made and abandoned, although as it later proved the image of the planet was on the plates all the time. Had the searchers read more carefully the text accompanying the statement of the location of the planet, there should have been no need in fact to consult the computer at all. I trust that there will be no occasion to transmit information of this sort however in the present case, since the planet's existence is well assured, and it is in my belief now pretty accurately located.

In my recent paper dealing with planet *P*, and published in POPULAR ASTRONOMY, 1931, **39**, 385, I used the same Correcting angle —11° as I did for Pluto, but it is now certain that the value of this angle depends, at least somewhat, on the ratio of the distances from the Sun to the two planets concerned. This is true because for an inner unknown planet the correction becomes positive, and would therefore be zero if the two planets were at the same distance. How it varies with that distance we have as yet no means of knowing by actual observation, but it is very clear that while it must change rapidly when the difference of the distances is small, it will change much more slowly as the distance increases. Using the method by which we computed the location of Pluto, as described in *H.A.*, **82**, 56, and omitting correction *C*, which is always small, and rather uncertain, we obtain for the Correcting angle in 1912 the value —16°.9. In the case of Pluto the Correcting angle was rather too small numerically, I have therefore increased it to —18°. This would place the planet in 1932.0 in $\alpha = 20^h\,08^m$, $\delta = -53°.9$.

It will be noted that the apparent location of the orbit in the sky is unchanged, so that any photographs of the region already taken will be just as useful as before. What has occurred is that we now believe the planet to have been from 6° to 7° farther behind Uranus in its orbit, both in 1812 and in 1912 than we had formerly assumed. Two other positions on the orbit have been computed as before, which may be of use in predicting positions for earlier or later dates, or for searching for the planet in case it is not found near its predicted location. One is for 1912.0 in $\alpha = 19^h\,12^m$, $\delta = -57°.9$, the other for 1952.0 in $\alpha = 20^h\,50^m$, $\delta = -49°.2$. The argument of the perihelion is now reduced from 170°.5 to 164°.9, but the date remains unchanged. The longitude of the perihelion obviously undergoes a change like that of the argument.

While a photographic search should give the ultimate answer as to the visibility of this object within the region examined, a brief preliminary visual examination might succeed in picking it out by means of its disk, which is over 1″ in diameter, and would give it the appearance of a minute planetary nebula. A magnification of 250 to 300 would be required, which should give sweeps 10′ in width, and perhaps 4° in length. The position of any planetary nebula found should be recorded, and its position with regard to the neighboring stars sketched. While this would not cover the full width of the region proposed for the photographic search, and a small, faint disk might be overlooked, yet with a telescope

large enough to show clearly a stellar disk to a star of magnitude 11, it is possible that the planet might be quickly discovered in this manner. Such a search conducted for even a few nights only in the most plausible region might possibly save much time in the end.

PRIVATE OBSERVATORY, MANDEVILLE, JAMAICA, B.W.I., OCTOBER 28, 1931.

THE GLASGOW ASTRONOMICAL CLASS

By THOMAS L. MAC DONALD*.

In this paper some account is given of classes in elementary astronomy for adults, which have now been conducted in Glasgow, Scotland, for seven sessions. It is believed that these classes form the largest recent experiment in Britain towards the diffusion of popular knowledge of the stars. Comparison with the work of the Amateur Astronomers Association, and other recent activities in America, naturally suggests itself. It is hoped that the experience gained will be of some value elsewhere; and one might suggest that parallel accounts from American organizers would be of interest here.

The idea of forming classes arose out of discussions in the Council of the West of Scotland Branch of the British Astronomical Association. Anyone may become an Associate of the branch by paying a subscription of 2s. 6d. (60 cents) per year. Naturally many enter out of a general interest in the subject, and have neither read at all widely nor done any observation. Consequently they find large parts of the papers read at the meetings above their heads. And one cannot expect a member who finds himself in such a position to remain long an enthusiastic attendant. The result is a long list of lapsed members and arrears subscriptions. So the first idea was merely to run a class for members of the society; accommodation was the only difficulty.

However, lucky coincidences do sometimes happen; and before the year was out the University of Glasgow had formed with a voluntary body, the Workers' Educational Association—a non-political and non-sectarian organization—a committee to establish classes for adults in a variety of subjects at different points in the district. Such schemes have been in operation for a longer time at various English universities; but astronomy has not generally been regarded as a subject in sufficient demand for inclusion in the scheme. Still, we got into touch with the organizing secretary without delay, and in due course the committee passed a scheme for a trial class at the beginning of 1925. This was advertised by the committee; a circular was printed by the society and issued to all its members, ex-members, and a good many others who might be interested; and the press found space for a letter inviting those interested to write to me.

*President, British Astronomical Association, West of Scotland Branch.

The following are extracts from the syllabus of the class:

> *Object.* To discuss the questions that meet the absolute beginner, so that he may read non-mathematical books and papers, and make amateur observations with interest and understanding. No previous knowledge is assumed, in particular no knowledge of mathematics.
>
> *Syllabus.* (i). The forms and positions of the constellations; peculiarities of the brightest stars; planet-finding. (ii). Daily and annual "movements" of the stars. Apparent movement of the sun. Sundials. time. Seasons. Movement of the moon. Phases. Rising and setting. Movement of the planets. Eclipses, etc. (iii). The sun and his system. What is a star? Distances and sizes of stars. The spectroscope. Ideas of the universe. (iv). Observations without apparatus, and with an opera glass. Structure of a telescope. Use of a small telescope. (v). Practical work, *e.g.* Constellation drawing. Path of moon and planets among the stars. Apparent movements of stars. Construction of sundials, etc. Drawing the moon. Visits to telescopes.

Scarcely a logical scheme; rather directed to maintain interest. Obviously, too, all these subjects could not be dealt with in any detail in a course of ten meetings. It was found quite possible to give sufficiently accurate general ideas on the whole ground covered. About the last item, the visits to telescopes, included those arranged by the branch for its members; and it must be added that "class weather" became proverbial. On a later occasion a class met for ten occasions, always in rain, unless it were snow or fog!

Each meeting lasted two hours, from 8:00 to 10:00 in the evening. The following arrangement was found very satisfactory, particularly in avoiding boredom during the more difficult parts of the course. At the start a short description was given of one or more prominent constellations. This was followed by the most solid part of the lecture, from section (ii) of the syllabus. At the close our knowledge of one of the planets or of some type of star or nebula was illustrated with lantern slides. All this took a little over an hour. For the rest of the time the lecturer sat back and was cross-questioned, and if need be criticized. It was probably natural that discussion should be somewhat slow; anything exciting usually happening just on closing hour. The discussion time also gave an opportunity for talking over any recent events, aurorae, meteors, and so on; and of mentioning things to be looked for. Written questions could also be left on the lecture table. Opportunity was also taken to suggest definite practical work and discuss the results. My experience has been that the majority of such a class do not wish, or perhaps have not time for, definite exercises in observation. And conditions were generally unfavorable, not merely in the weather sense, for that direct appeal to observation which is certainly of value.

The number of students in the first class was 80. The attendance did not fall below 50 at any meeting. (This was the largest attendance of any subject under the scheme that year.) Ages varied from 16 to 70; occupations very diverse, printer, coal-miner, ferryman, steel-worker appearing on the list; and of several unemployed men, who had a right

to free admission, not all used their right. The fee was 30 cents.

In view of the success of the first class, the work was carried on during the whole of the following winter. In the first term, before Christmas, 1925, a similar general program was carried out. The wisdom of covering the whole ground rapidly was borne out, as a number of former students did not return; many of these were attending similar courses in other subjects, the range having been extended to include several other sciences. Others had joined the Astronomical Society, and could not also give time for the class. There were, however, many new members; and the method adopted had left sufficient blanks to enable the old members to get something new each week without leaving the newcomers lost.

From January to March, 1926, a more advanced course was given, and though the work was much more difficult, over 30 followed it to the end. It was interesting to find how much could be covered with such a group, almost entirely of the working class. There were no University men in it.

The first subject dealt with was the spectroscope, as far as the idea of line series, arc and spark, general nature of the Doppler and Zeeman effect, effective temperatures, etc. The individual characteristics of stars, some account of photometry, spectrum classification, and some conceptions of stellar evolution then followed. This naturally introduced at various points the formation of double stars, long period variables, Cepheids, linked in with clusters, and so streaming and the local cluster. The different types of nebula were classified, recent work on spiral nebulae getting a night to itself. Having thus formed a picture of the current ideas of the universe, we returned home, and devoted the rest of the course to tracing ideas on the formation of the solar system, the evidence on the age of the earth, and its history down to the point where contact is made with geology. The course ended with a brief account of the subject matter of geophysics, and the difficulties of comparing the earth with other planets were brought out.

The principal difficulty experienced was naturally that of dealing with the various points without mathematics. It was found that in most cases a relatively simple arithmetical treatment conveyed the essenial conceptions; and it is only fair to add that the majority of the class found the general ideas and methods involved easier to grasp than other points, for example connected with the motion of the planets. The latter subject is generally supposed to be more suited to popular exposition, largely because it has been common property for so much longer.

In the same term, following a largely attended course of public lectures, a second class was started in Paisley, about 7 miles away; this class and subsequent activities in Glasgow followed the lines already indicated. Preliminary work in Hamilton was started in 1926 and in Stirling in 1928.

A few general impressions on the class work may be of service. I am

not aware of any study ever having been made on the questions involved in the teaching of popular astronomy.

The most valuable information is derived from the questions asked. There were two definite types, points of fact or curiosity questions, and real difficulties of understanding.

For a certain number, definite figures, however doubtful, seem to have a fatal attraction—even if the figures are quite incomprehensible to them or anybody else. Points connected with ancient knowledge, and other historical points seem specially fascinating; I suppose because of the human element. There are always some who wish to discuss philosophical and even theological aspects. I found it very profitable to allow discussion on the aims and ideals of science; astronomy is better suited than the more traditional school sciences—on this side at least—to give immediate insight into the methods of science. The theological questions, apart from emphasizing what science does not prove, were of course taboo.

Of the genuine difficulties of understanding, a remarkable proportion centered round certain geometrical aspects of the subject. The difficulties experienced suggest that these are passed over far too glibly in books intended for the general public. I found it possible to reduce the difficulties to three main heads; those who obtained, or already had, clear ideas on these found the later work much less puzzling.

The first head is the nature and use of angles. There are plenty of jokes at the expense of those who see a meteor a yard long. But my experience is that the majority of beginners require a definite training in the meaning, and especially in the estimation of angles. A point of repeated occurrence is—I copy from a written question—"Why is it that the moon—a small body—is able to cover the sun—a large body?" This point presents difficulties which might not be expected.

The second matter is the visualization of simultaneous motions. It is easy, with familiar apparatus, to make perfectly clear the separate motions of, say, earth, sun, and moon; but it is a different matter when it comes to the effect of these motions simultaneously; and such problems as the true path of the moon about the sun present amazing difficulties to those without mathematical training. The matter of relative and apparent motion also deserves very great care; the whole question of relative and apparent motion is very poorly treated in almost all text-books of physics and astronomy. The question is by no means solved by sending the student out to look at the stars throughout a year; it is simply not true that for the naked eye observer Copernicus is an advance on Ptolemy.

The third difficulty comes generally somewhat later; it is that of visualizing in three dimensions. In the usual diagrams on flat paper many misunderstandings are bred, like the question, "Will Eros ever bump into Mars when crossing his orbit?" Similar difficulties occur in visualizing what Proctor called "Sun-views of the Earth." It is a useful ex-

ercise to spend some time visualizing the aspect of the heavens from another planet.

The value of a wide range of simple apparatus and devices for illustrating various points needs no illustration. A reference collection of such devices would save much time. I hope to describe later a very primitive but adaptable form of orrery employed for many purposes. A modified form of Marth's Intercepts was also found of use.

The value of work of the type described does not depend on the amount of fact-knowledge conveyed; but on the development of a new interest in the life of the student. The spread of a general appreciation of astronomy is a third type of teaching, equally different from the formal work of the university and from the needs of the observing amateur. And a really widespread appreciation of our position in the universe, as revealed by modern astronomy, would prove of very high value in the present position of civilization as a whole.

GLASGOW, SCOTLAND, MAY, 1931.

PLANET NOTES FOR JANUARY, 1932

By CLIFFORD E. SMITH.

The *Sun* will be moving with an apparent northeasterly motion from the central part of Sagittarius to the central part of Capricornus. On January 2 the earth will pass through its perihelion point. At that time the earth's distance from the sun will be about 91.35 million miles. During the month the distance from the earth to the sun will increase about 190 thousand miles. The position of the sun on the first and last days of the month will be, respectively: R.A. $18^h\ 41^m$, Decl. $-23°\ 7'$; R.A. $20^h\ 49^m$, Decl. $-17°\ 47'$.

The phenomena of the *Moon* will occur as follows:

New Moon	Jan.	7 at	5 P.M.	C.S.T.
First Quarter		15 "	3 P.M.	"
Full Moon		23 "	8 A.M.	"
Last Quarter		30 "	4 A.M.	"
Perigee		2 "	5 A.M.	"
"		27 "	3 A.M.	"
Apogee		15 "	3 A.M.	"

Mercury during this period will be a morning star of magnitude about zero, rising somewhat more than an hour before the sun. Its apparent motion will be easterly from the southern part of Ophiuchus to the eastern part of Sagittarius. The distance from the earth to Mercury will be about 75 million miles at the beginning of the month, and this distance will increase to about 120 million miles by the end of the month. The apparent diameter of the disc of Mercury will decrease from about eight to about five seconds of arc. Conjunction with the moon will occur on January 6 (Mercury 7° north). Greatest elongation west will occur on January 11.

Venus will be an evening star of brightness about magnitude —3, setting about two hours after the sun. Its apparent motion will be direct from the central part of Capricornus to the eastern part of Aquarius. Its distance from the earth will

decrease during this period from about 133 to about 118 million miles, and its apparent diameter will increase from about twelve to about thirteen seconds of arc. Conjunction with the moon will occur on January 10 (Venus 2° north).

Mars will be too near the sun in apparent position to be of interest. Conjunction with the sun will occur on February 1.

Jupiter will be a morning star in western Leo of about magnitude —2, rising about eight in the evening during the middle of the month. Its apparent motion during this period will be retrograde. Its distance from the earth during this period will be about 400 million miles, and its apparent diameter will be about 42 seconds of arc. Conjunction with the moon will occur on January 24 (Jupiter 2° south).

Saturn will be near the sun in apparent position. Conjunction with the sun will occur on January 16.

Uranus will continue as an evening object in eastern Pisces. During the middle of the month it will be on the meridian about $5^h\,30^m$ in the afternoon. Its apparent diameter will be about 3½ seconds of arc, and its distance from the earth will be about 1900 million miles. On January 7 Uranus will be at quadrature east of the sun, and on January 15 it will be in conjunction with the moon. Its apparent motion during this period will be direct.

Neptune will be a morning object in central Leo (in the same constellation as Jupiter). Its apparent motion in the sky will be retrograde, and its apparent diameter will be about 2½ seconds of arc. During the middle of the month it will be on the meridian about three in the morning, and its distance from the earth will be about 2700 million miles. Conjunction with the moon will occur on January 26.

OCCULTATIONS

OCCULTATIONS VISIBLE IN LONGITUDE +72° 30′, LATITUDE +42° 30′.
(Contributed by the office of the *American Ephemeris*.)

Date 1932		Star	Mag.	IMMERSION Greenwich C.T. h m	IMMERSION a m	IMMERSION b m	IMMERSION Angle E from N °	EMERSION Greenwich C.T. h m	EMERSION a m	EMERSION b m	EMERSION Angle E from N °
Jan.	13	337 B.Aqr	6.4	0 40.2	—1.0	—1.5	91	1 35.8	—0.1	+1.1	202
	16	π Psc	5.6	0 16.7	—2.6	—2.0	106	1 12.8	—0.7	+3.1	188
	20	38 B.Aur	6.5	4 13.2	—1.8	+0.3	61	5 21.4	—0.8	—2.4	297
	20	406 B.Tau	5.6	21 15.0	—0.2	+1.3	91	22 15.2	—0.3	+1.8	246
	22	47 Gem	5.6	7 51.2	—0.8	—1.2	92	8 50.8	0.0	—2.0	304
	23	4 Cnc	6.2	2 40.9	..	..	23	2 51.7	..	..	6
	28	200 B.Vir	6.3	3 28.6	..	..	199	3 41.1	..	..	222
	28	f Vir	6.0	6 3.6	—0.2	—1.6	168	6 56.2	—1.8	+1.1	267
	29	550 B.Vir	6.0	9 33.3	—1.9	—0.2	103	10 43.0	—1.0	—1.5	331
OCCULTATIONS VISIBLE IN LONGITUDE +91°, LATITUDE +40°.											
Jan.	4	π Sco	3.0	19 4.8	—1.3	—2.1	136	19 55.7	—0.1	—0.6	240
	13	337 B.Aqr	6.4	0 17.0	—1.5	—0.3	72	1 28.2	—0.5	+0.9	211
	13	342 B.Aqr	6.5	1 54.6	—0.7	—0.3	62	3 1.3	—0.3	0.0	230
	15	π Psc	5.6	23 29.3	—2.2	+1.0	75	0 49.6	—1.1	+2.2	207
	20	38 B.Aur	6.5	3 35.1	—2.1	+0.6	74	5 1.3	—1.9	—1.0	273
	22	47 Gem	5.6	7 39.2	—0.9	—2.0	126	8 46.5	—1.0	—1.3	271
	22	134 B.Gem	6.5	10 21.5	—0.7	—0.6	65	11 3.2	+0.7	—2.2	330
	23	4 Cnc	6.2	2 11.1	..	..	27	2 32.4	..	..	351
	29	550 B.Vir	6.0	9 9.4	—0.8	—0.7	142	10 20.7	—1.6	—0.3	294
	31	153 B.Lib	6.3	13 28.9	—2.2	—0.1	82	14 41.1	—1.6	—1.6	320

OCCULTATIONS VISIBLE IN LONGITUDE +120°, LATITUDE +36°.

Date 1932	Star	Mag.	IMMERSION Greenwich C.T.	IMMERSION a	IMMERSION b	IMMERSION Angle E from N	EMERSION Greenwich C.T.	EMERSION a	EMERSION b	EMERSION Angle E from N
			h m	m	m	°	h m	m	m	°
Jan. 4	A Sco	4.6	15 4.1	—2.7	+1.6	69	15 57.3	—0.5	—1.6	343
4	π Sco	3.0	18 23.9	—1.9	—1.4	132	19 35.0	—1.7	—0.7	258
13	342 B.Aur	6.5	1 23.1	—0.9	+1.6	28	2 39.0	—1.6	—0.1	248
20	38 B.Aur	6.5	2 37.9	—1.1	+2.2	57	3 57.8	—2.1	+0.5	269
20	47 B.Aur	6.0	6 5.1	—2.4	+3.0	38	7 3.6	—1.7	—3.7	314
22	134 B.Gem	6.5	10 3.8	—0.8	—1.9	123	11 10.5	—0.8	—1.4	277
25	34 Leo	6.4	11 1.2	—1.9	—0.9	101	12 6.4	—0.5	—2.5	335
31	153 B.Lib	6.3	12 38.7	—0.9	—0.4	136	13 52.1	—1.9	+0.1	282

The quantities in the columns a and b are given for the purpose of making these predictions useful for any place within 200 miles of the point indicated. The procedure is as follows: Subtract the longitude of the point given from the longitude of the place in question; multiply the result, taking the signs into account, by the quantity under a for the star to be observed; similarly, with the latitude, using b; apply the sum of the products, with its proper sign, to the Greenwich C.T., and obtain the predicted Greenwich Civil Time for the phenomenon at the place of observation. To obtain Eastern Standard Time it is necessary to subtract five hours; Central Standard Time, six hours, etc.

VARIABLE STARS

Monthly Report of the American Association of Variable Star Observers for October, 1931

The Twentieth Annual Meeting held at the Harvard Observatory on October 17, though attended by fewer members than usual, was perhaps more enjoyed by those few than any meeting held in recent years. Seventeen new members, including two life members, were elected by the council, and though a few were dropped for one reason or another, the total membership still numbers more than 300.

Director Shapley, with the advice of the Council, has appointed Mr. Campbell the first Pickering Memorial Astronomer, and the Council voted to have him designated in the A.A.V.S.O. reports as "Recorder" instead of Recording Secretary; this to avoid possible confusion with Mr. Olcott, the regular Secretary of the Association.

Newly elected officers of the Association are:

President . . . . . Harriet W. Bigelow
First Vice President . . . . . Harlow Shapley
Second Vice President . . . George Van Biesbroeck

Messrs. Olcott and Witherell will continue to serve as Secretary and Treasurer respectively. New members of the Council are Inez L. B. Clough and George C. Waldo. Miss Farnsworth, as retiring President, automatically becomes a member of the Council.

The papers presented proved of more than passing interest. Professor W. P. Gerrish's description of old, historic astronomical instruments was informative and comprehensive. Dr. W. J. Fisher gave us another detailed, statistical account

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1931.

Aug. 0 = J.D. 2426554; Sept. 0 = J.D. 2426585; Oct. 0 = J.D. 2426615.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
S SCL	R AND	V AND	S PSC	U PER	Z CEP
001032	001838	004435	011208	015254	021281
558 10.9 En	620 13.5 Ma	605 13.0 L	605 11.6 L	588 8.7 Ry	621 14.0 Br
568 10.6 En	621 13.3 Br	621 13.8 Br	621 12.2 Br	592 8.7 Jo	623 13.8 Pt
X AND	S TUC	623 14.0 B	S CAS	593 8.7 Ry	o CET
001046	*001862*	RR AND	011272	594 8.6 Jo	*021403*
578 11.9 Bw	558 11.9 En	004533	623 13.0 B	596 8.7 Ry	573 6.4 Sl
592 12.3 Jo	565 12.4 En	623 11.4 B	U PSC	597 8.6 Jo	592 7.4 Jo
594 12.5 Jo	S CET	RV CAS	011712	602 8.7 Jo	593 7.3 Sl
597 12.5 Jo	*001009*	004746a	602 11.1 L	602 8.5 Pt	597 7.5 Jo
617 13.4 Al	591 10.0 Mp	621[14.8 Br	602 11.1 Pt	603 8.7 Ry	602 7.7 Jo
621 12.8 Br	592 10.0 Jo	623[14.0 B	RZ PER	606 8.8 Ry	603 7.9 L
624 13.3 B	594 10.0 Jo	624[13.9 Bg	012350	606 8.9 BL	605 7.4 Sl
627 13.3 Bw	598 9.9 Jo	— CAS	610 9.8 L	609 8.6 Jo	609 7.6 Jo
T CET	602 9.5 L	004746b	624 9.7 Pc	613 8.7 BL	615 8.3 Ma
001620	602 10.4 Pt	602 10.6 Pt	R PSC	614 8.6 Jo	619 8.1 Gy
602 6.0 L	603 9.5 Jo	624 10.5 Bg	012502	614 8.7 Ry	623 8.4 Pt
T AND	617 8.7 Sf	W CAS	602 9.0 Pt	617 8.7 BL	S PER
001726	622 8.6 Sf	004958	621 8.2 Br	617 8.5 Me	021558
592 12.0 Jo	628 8.5 Sf	576 12.0 Fd	RU AND	619 8.4 Mc	592 8.5 Jo
594 11.8 Jo	T PHE	578 11.9 Bw	013238	620 8.6 BL	593 9.6 Ah
602 11.5 Pt	*002546*	592 12.0 Jo	594 11.3 Jo	622 8.2 Mc	594 8.7 Jo
603 10.0 Jo	559[13.0 En	594 12.1 Jo	597 11.0 Jo	625 8.8 Al	597 8.6 Jo
604 10.5 Md	Y CEP	597 12.5 Jo	602 10.7 Pt	626 8.3 Mc	602 8.6 Jo
609 9.8 Jo	003179	602 11.8 Jo	604 10.6 Md	627 8.9 BL	606 10.0 BL
614 9.7 Jo	621 14.2 Br	602 12.3 Pt	610 10.1 L	S ARI	613 10.0 BL
618 9.8 Md	α CAS	603 11.8 BL	617 10.1 Ma	015912	613 9.2 Sz
619 9.6 Gy	003455	606 11.7 BL	620 10.5 Md	621[14.3 Br	614 8.5 Jo
624 9.7 B	589 2.3 Oy	609 12.0 Jo	624 10.3 Bg	R ARI	615 9.8 Ah
624 9.7 Bg	589 2.5 Ko	613 11.9 BL	627 11.0 Ma	021024	617 10.0 BL
626 9.8 Md	590 2.5 Ko	614 12.2 Jo	Y AND	593 10.4 Ah	620 10.1 BL
T CAS	591 2.4 Ko	615 11.5 Bw	013338	603 10.7 L	623 9.5 Pt
001755	592 2.3 Ko	617 11.7 BL	602 13.7 Pt	620 12.4 Ma	624 9.2 Bg
591 11.1 Mp	593 2.3 Ko	619 11.6 Mc	617[12.6 Ma	623 13.0 Pt	627 10.0 BL
591 10.9 Mn	594 2.3 Ko	620 11.5 BL	623 14.1 B	624 12.7 Fd	631 10.0 Fd
592 10.6 Jo	595 2.4 Ko	623 11.0 B	627[11.5 Ma	631 12.8 Fd	R CET
594 10.6 Jo	596 2.4 Ko	624 11.2 Pc	X CAS	W AND	*022000*
597 10.5 Jo	597 2.3 Ko	624 11.2 Bw	014958	021143a	603 13.5 L
600 10.7 Mn	598 2.4 Ko	627 11.4 BL	592 11.0 Jo	593 9.7 Ah	621 12.9 Br
600 10.2 We	599 2.5 Ko	U TUC	594 11.0 Jo	615 10.2 Ah	RR PER
602 11.3 Pt	600 2.2 Ko	*005475*	597 11.0 Jo	619 10.3 Gy	022150
602 10.4 Jo	603 2.3 Ko	585 14.0 Sl	602 10.8 Jo	623 10.5 Pt	594 10.0 Jo
602 10.0 Bg	606 2.4 Ko	593 13.6 Sl	602 11.7 Pt	624 10.8 Pc	609 9.9 Jo
604 10.5 Jo	607 2.4 Ko	601 13.2 Sl	609 10.7 Jo	T PER	610 10.3 L
605 10.8 L	609 2.2 Ko	605 12.7 Sl	614 10.7 Jo	021258	614 9.7 Jo
609 9.7 Jo	611 2.2 Ko	Z CET	623 10.4 B	592 8.6 Jo	621 10.0 Br
610 9.7 B	613 2.4 Ko	*010102*	U PER	593 8.6 Ah	623 9.5 Pt
614 9.6 Jo	U CAS	602 13.3 L	015254	594 8.5 Jo	U CET
615 10.4 Mn	004047	U AND	509 11.1 Ry	597 8.6 Jo	*022813*
617 9.4 Me	602 13.4 Pt	602 13.8 Pt	513 10.9 Ry	602 8.6 Jo	602 10.8 L
617 9.0 Al	605 12.3 L	602[14.3 L	518 10.5 Ry	606 8.8 BL	619 9.8 Gy
619 9.5 Mc	605 12.3 Md	070940	529 10.0 Ry	613 9.0 BL	623 9.8 Pt
622 9.4 Mc	610 12.0 B	621[13.8 Br	535 10.0 Ry	614 8.6 Jo	RR CET
626 9.2 Mc	615 11.5 Bw	UZ AND	543 9.8 Ry	615 8.7 Ah	022980
R AND	616 11.4 Sf	011041	550 9.5 Ry	617 8.8 BL	621 14.4 Br
001838	619 11.6 Me	605 11.4 L	572 9.2 Ry	620 8.8 BL	627[13.5 Ie
602 13.7 Pt	620 11.1 Sf	615 10.7 Bw	576 8.9 Fd	623 8.4 Pt	R TRI
617 12.7 Al	624 11.0 Bw	615 10.9 Ma	577 8.9 Ry	627 8.9 BL	023133
618 11.2 Wd	628 10.0 Sf	625 9.9 Bw	581 8.8 Ry		590 9.2 Mn

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1931.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R TRI	R HOR	W TAU	R ORI	T ORI	Z TAU
023133	*025050*	042215	045307	*053005a*	054615a
592 8.5 Jo	563 8.7 Sl	592 10.8 Jo	607 11.6 Br	606 11.1 Pt	607 10.8 Br
593 9.0 Ah	573 9.1 Sl	595 10.7 Jo	610 11.5 L	608 10.9 Pt	614 10.5 Ma
594 8.7 Jo	593 10.2 Sl	597 10.7 Jo	622 11.3 Br	610 10.1 L	RU TAU
597 8.8 Jo	601 10.4 Sl	602 10.6 Jo	R LEP	614 11.2 Ma	054615c
597 9.3 Ad	T HOR	610 10.9 L	*045514*	615 11.1 Ma	602 10.8 L
599 9.1 Ah	*025751*	624 10.4 Pt	563 7.8 Sl	617 11.1 Ma	607 11.0 Br
600 9.3 Mn	563 8.5 Sl	624 10.6 Fd	593 7.4 Sl	624 10.4 Pt	614 11.0 Ma
602 9.2 Jo	573 9.3 Sl	S TAU	601 7.3 Sl	626 10.5 Pt	α ORI
604 9.3 Wd	601 11.0 Sl	042309	602 8.0 L	627 9.8 Ma	054907
615 9.7 Wd	605 11.1 Sl	606 11.7 Br	606 7.4 Pt	AN ORI	620 0.3 Mc
615 9.6 Ma	U ARI	615 11.8 Ma	615 8.0 Ma	*053005t*	626 0.4 Mc
615 9.8 Ah	030514	622 11.8 Br	V ORI	614 11.7 Ma	U ORI
617 9.8 Sf	603 12.1 L	624 11.8 Pt	050003	615 11.2 Ma	054920a
618 9.7 Ad	X CET	T CAM	606 11.5 Pt	617 11.2 Ma	563 10.9 Sl
618 9.8 Wd	*031401*	043065	607 11.4 Br	627 11.4 Ma	592 10.5 Ah
619 10.2 Gy	592 11.0 Jo	592 8.7 Jo	610 11.8 L	S CAM	593 9.5 Sl
622 9.9 Sf	595 10.8 Jo	594 8.3 Jo	622 12.5 Br	053068	601 9.4 Sl
623 10.0 Pt	598 10.7 Jo	597 8.3 Jo	T LEP	576 8.6 Fd	624 8.7 Pt
624 10.1 Wd	602 10.5 L	602 8.2 Jo	*050022*	592 8.7 Jo	V CAM
624 9.9 Fd	623 9.9 Pt	606 8.0 Br	606 11.9 Pt	595 8.5 Jo	054974
627 9.8 Ad	631 9.7 Fd	606 7.9 BL	R AUR	597 8.4 Jo	606 11.7 Br
628 10.5 Sf	Y PER	610 8.0 L	050953	624 8.7 Pc	624 9.3 Pt
T ARI	032043	615 7.9 Jo	593 9.2 Ah	624 8.6 Pt	Z AUR
024217	592 8.4 Jo	617 8.2 BL	601 9.0 Br	RR TAU	055353
619 8.7 Me	592 8.9 Ah	620 8.2 BL	611 8.3 Ah	053326	597 10.1 Pt
W PER	593 9.0 Ah	624 8.2 Pc	615 8.6 Ah	602 10.9 L	598 10.1 Pt
024356	595 8.4 Jo	624 8.0 Pt	623 8.3 Br	603 10.8 L	601 10.1 Pt
508 9.5 Ry	597 8.4 Jo	627 8.3 BL	624 8.4 Pt	606 10.9 Br	603 10.0 Pt
513 9.3 Ry	599 9.2 Ah	RX TAU	NOV TAU	610 10.5 L	604 10.1 Pt
518 9.2 Ry	602 8.5 Jo	043208	051316	623 12.3 Br	606 10.2 Pt
522 9.1 Ry	606 9.3 BL	607 11.5 Br	603 14.3 L	RV AUR	608 10.0 Pt
529 9.2 Ry	614 8.6 Jo	610 11.8 L	S AUR	053337	619 9.8 Mc
535 9.2 Ry	615 9.6 Ah	622 12.0 Br	052034	606 14.0 Br	622 9.6 Mc
550 9.2 Ry	617 9.3 BL	R RET	592 8.7 Jo	624 12.7 Pc	624 10.0 Pt
572 9.5 Ry	619 9.2 Mc	*043263*	594 8.6 Jo	U AUR	626 10.1 Pt
577 10.0 Ry	620 9.5 BL	563 12.7 Sl	597 8.4 Jo	053531	626 9.9 Mc
581 10.0 Ry	623 9.1 Pt	586 11.2 Sl	602 8.2 Jo	606 12.8 Br	R OCT
588 10.0 Ry	626 8.8 Mc	593 11.0 Sl	622 9.5 Mc	624 13.0 Pt	*055686*
592 9.3 Jo	627 9.6 BL	601 10.5 Sl	624 8.3 Pt	SU TAU	556 9.4 En
593 10.1 Ry	R PER	X CAM	626 9.9 Mc	054319	558 9.2 Bl
594 9.5 Jo	032335	043274	W AUR	597 10.0 Pt	563 8.4 Sl
596 10.1 Ry	615 9.7 Ma	598 10.8 Jo	052036	602 9.7 L	565 8.1 Bl
597 9.7 Jo	623 9.4 Pt	603 11.6 L	603 14.5 L	604 10.5 Pt	568 8.0 En
602 9.8 Jo	624 8.9 Pc	624 12.0 Pc	606 14.5 Br	606 10.7 Pt	573 8.1 Bl
603 10.2 Ry	631 9.0 Fd	624 12.1 Pt	620 13.3 Ma	606 9.9 Br	X AUR
606 10.2 Ry	NOV PER	R DOR	623 14.0 Br	608 10.8 Pt	060450
614 10.1 Ry	032443	*043562*	624 13.8 Pt	610 9.6 L	603 10.3 L
614 10.0 Jo	623 13.6 Pt	563 5.4 Sl	S ORI	614 9.8 Ma	624 11.6 Pc
614 9.5 Bg	T FOR	571 5.3 Sl	*052404*	617 9.9 Ma	624 11.4 Pt
615 10.2 Bw	*032528*	593 5.1 Sl	615 9.5 Ma	621 9.6 Br	V AUR
617 10.5 Me	602 9.3 L	601 5.0 Sl	623 9.6 Br	623 9.7 Br	061647
619 10.8 Mc	610 9.2 L	605 5.0 Sl	624 9.3 Pt	624 9.5 Pc	603 10.5 L
622 10.5 Mc	R TAU	V TAU	T ORI	624 9.6 Pt	V MON
623 10.0 Pt	042209	044617	*053005a*	626 9.6 Pt	*061702*
624 10.8 Bw	606 11.5 Br	600 9.6 Br	602 10.3 L	627 9.8 Ma	606 8.8 Pt
624 10.1 Bg	615 11.0 Ma	624 9.1 Pt	603 11.4 L	Z TAU	AG AUR
629 10.3 Mc	622 11.8 Br	627 9.3 Ie	604 11.0 Pt	054615a	062047
631 10.4 Fd	624 11.6 Pt		605 11.3 L	602 11.0 L	603 9.2 L

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1931.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
U LYN	TW GEM	T HYA	RV CAR	R UMA	R CRV
063159	070122c	*085008*	*095563*	103769	*121418*
606 14.0 Br	604 8.2 Pt	610 9.4 L	555[12.5 En	615 8.9 Ah	585 6.7 Sl
R MON	R CMI	T CNC	558[13.1 Bl	618 9.0 Wd	T CVN
063308	070310	085120	S CAR	619 9.2 Gy	122532
606 11.7 Pt	604 9.1 Pt	604 8.0 Pt	*100661*	619 8.7 Mc	554 10.0 Ch
S LYN	610 9.1 L	V UMA	555 6.0 En	622 9.0 Mc	U CEN
063558	L_2 PUP	090151	556 5.9 Sl	625 9.8 Wd	*122854*
535 10.3 Ry	*071044*	622 10.3 Mc	558 5.8 Bl	V HYA	555 9.6 En
577 9.8 Ry	563 5.1 Sl	RW CAR	561 6.0 En	*104620*	558 9.2 Bl
593 10.6 Ry	571 5.1 Sl	*091868*	562 5.9 Sl	556 7.5 En	565 9.4 Bl
595 10.7 Ry	593 5.6 Sl	556 12.8 En	565 5.7 Bl	558 6.0 Bl	568 9.9 En
600 10.8 Ry	601 5.3 Sl	558 12.5 Bl	568 6.2 En	565 6.2 Bl	573 10.3 Bl
603 11.0 L	605 4.7 Sl	Y VEL	569 5.8 Sl	RS HYA	T UMA
606 10.9 Ry	S CMI	*092551*	573 5.8 Sl	*104628*	123160
624 12.3 Pt	072708	556[12.9 En	573 5.5 Bl	558[13.0 Bl	567 12.2 Ch
X GEM	604 7.3 Pt	558[12.4 Bl	585 6.0 Sl	W LEO	592 10.7 Jo
064030	T CMI	R CAR	593 6.2 Sl	104814	593 11.0 Ah
627 8.3 Ma	072811	*092962*	601 6.5 Sl	633 10.8 Ma	595 10.6 Jo
Y MON	604 12.0 Pt	556 5.8 En	605 6.9 Sl	RS CAR	597 10.0 Jo
065111	S VOL	558 5.8 Bl	U UMA	*110361*	597 10.8 Pt
606 10.1 Pt	*073173*	561 5.5 En	100860	556[12.3 Sl	599 10.1 Ah
607 10.2 Br	558 9.7 Bl	562 5.5 Sl	590 6.1 Mn	RY CAR	600 10.1 Mn
610 9.9 L	565 9.9 Bl	565 5.6 Bl	601 6.3 Mn	*111561*	602 9.8 Jo
627 11.5 Ma	573 10.8 Bl	569 5.5 Sl	615 6.5 Mn	555 11.6 En	602 9.7 Pc
X MON	U CMI	573 5.4 Sl	Z CAR	558 11.6 Bl	603 9.8 Wd
065208	073508	573 5.6 Bl	*101058a*	561 10.8 En	609 9.6 Jo
603 7.9 L	603 9.0 L	593 5.4 Sl	558[12.6 Bl	565 11.3 Bl	611 8.7 Ah
R LYN	604 9.2 Pt	595 5.8 Sl	W VEL	568 11.0 En	613 8.7 Ma
065355	S GEM	Y DRA	*101153*	573 11.3 Bl	614 8.5 Jo
593 8.6 Ah	073723	093178	558 10.0 Bl	584 11.2 En	614 8.5 Me
599 8.4 Ah	604 9.6 Pt	587 9.6 Be	565 10.1 Bl	RS CEN	615 8.6 Ah
610 7.3 L	T GEM	587 9.5 L	573 10.3 Bl	*111661*	618 8.7 Wd
615 7.8 Ah	074323	R LMI	RZ CAR	555 11.2 En	625 7.9 Wd
621 6.9 Br	604 8.8 Pt	093934	*103270*	558 11.8 Bl	R VIR
624 7.5 Pt	627 9.0 Ma	604 10.0 Pt	555 12.4 En	561 11.9 En	123307
627 7.8 Ma	R CNC	R LEO	561 13.1 En	565 12.5 Bl	541 7.4 Ch
RS GEM	081112	094211	R UMA	568 12.7 En	RS UMA
065530	604 9.5 Pt	604 10.0 Pt	103769	573 13.1 Bl	123459
627 10.6 Ma	V CNC	633 10.3 Ma	554 7.8 Ch	X CEN	508 12.3 Ry
Z CMA	081617	1 CAR	564 7.8 We	*114441*	514 12.1 Ry
065911	603 7.7 L	*094262*	584 7.4 We	556 9.0 En	519 11.8 Ry
563 9.5 Sl	604 7.8 Pt	563 3.4 Sl	587 8.2 Mn	558 8.4 Bl	522 11.4 Ry
573 9.7 Sl	R CHA	571 3.9 Sl	591 8.3 Mn	561 8.8 En	532 10.4 Ry
593 9.1 Sl	*082476*	585 3.5 Sl	592 8.0 Jo	565 8.5 Bl	535 10.4 Ry
601 9.5 Sl	558 12.6 Bl	587 3.4 Sl	592 7.6 We	573 8.5 Bl	541 9.7 Ch
605 9.4 Sl	562 12.2 Sl	593 3.4 Sl	592 8.2 Ah	W CEN	558 9.5 Ry
V CMI	573 12.0 Bl	601 3.5 Sl	593 8.2 Ah	*115058*	564 8.8 Ch
070109	586 11.1 Sl	Z VEL	594 8.1 Jo	555[12.6 En	569 9.2 Ry
604 8.1 Pt	593 11.0 Sl	*094953*	597 8.1 Jo	558[12.6 Bl	577 9.2 Ry
610 8.0 L	601 10.3 Sl	555[12.1 En	599 8.5 Ah	568[12.6 En	579 9.4 Ch
R GEM	U CNC	558[12.8 Bl	600 8.4 Mn	R COM	581 9.3 Ry
070122a	083019	V LEO	602 8.2 Pc	115919	587 9.3 Mn
604 12.7 Pt	603 10.3 L	095421	603 8.0 Wd	509 10.6 BL	588 9.3 Ry
621 12.2 Br	627 11.2 Ma	604 10.8 Pt	607 8.6 Wd	512 10.5 BL	592 8.7 Jo
Z GEM	S HYA	633 12.7 Ma	609 8.2 Jo	R CRV	593 10.4 Ry
070122b	084803	RR CAR	611 8.9 Ah	*121418*	595 9.5 Jo
604 12.5 Pt	604 10.4 Pt	*095458*	614 7.8 We	556 7.8 Sl	596 10.6 Ry
		556 7.8 En	614 8.6 Jo	565 7.2 Sl	597 10.2 Pt
			615 8.9 Wd	569 6.8 Sl	597 10.0 Jo

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1931.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RS UMA	R HYA	T APS	V BOO	S APS	R NOR
123459	*132422*	*134677*	142539a	*145971*	*152849*
600 10.2 Mn	573 9.3 Bl	558 13.0 Bl	576 8.6 Fd	565 11.4 Bl	558 13.1 Bl
600 10.4 Ry	584 9.7 En	561[12.7 En	590 8.8 Mn	569 11.4 En	561 12.8 En
602 10.4 Jo	599 9.3 Sl	RU HYA	592 8.3 Jo	569 11.4 Sl	X LIB
602 10.3 Pc	602 9.1 Sl	*140528*	593 8.7 Ah	573 11.4 Bl	*153020*
603 10.3 Wd	S VIR	557 8.3 En	594 8.4 Jo	577 11.5 Bl	558[12.8 Bl
606 10.6 Ry	*132706*	557 7.8 Bl	597 8.6 Jo	583 11.0 En	W LIB
609 10.7 Jo	539 7.2 Ch	558 7.8 Bl	597 8.7 Pt	586 11.1 Sl	*153215*
613 11.1 Ma	557 8.0 En	561 8.2 En	599 8.8 Ah	RT LIB	559 12.2 Bl
614 10.9 Jo	561 8.1 En	565 8.2 Bl	600 8.9 Mn	*150018*	568 13.0 Ch
S UMA	563 7.8 Sl	577 8.4 Bl	602 8.6 Jo	570[13.0 Bs	S UMI
123961	569 7.9 Sl	584 8.6 En	602 8.6 Pc	T LIB	153378
531 8.9 Mn	579 8.6 Ch	R CEN	604 8.9 Sf	*150519*	554 8.6 Ch
541 8.2 Ch	580 8.2 En	*140959*	609 8.5 Jo	568 11.5 Ch	576 8.9 Fd
567 8.2 Ch	585 8.1 Sl	557 9.5 En	614 8.4 Jo	Y LIB	589 9.0 Ko
576 8.0 Fd	599 8.6 Sl	558 8.2 Bl	614 8.9 Sf	*150605*	592 8.4 Jo
592 8.4 Jo	RV CEN	561 9.5 En	615 8.8 Ah	610 9.7 L	593 9.0 Ah
593 8.6 Ah	*133155*	563 8.3 Sl	617 8.8 Me	S LIB	594 8.6 Jo
595 8.7 Jo	557 9.1 En	565 8.5 Bl	619 9.7 Mc	*151520*	595 8.9 Ko
597 8.8 Jo	558 8.8 Bl	569 9.5 En	621 9.0 Sf	568 11.5 Ch	597 8.7 Jo
597 8.8 Pt	561 9.1 En	577 8.8 Bl	622 9.8 Mc	S SER	600 9.3 Sf
599 8.7 Ah	565 8.7 Bl	580 9.9 En	626 9.8 Mc	151714	601 8.8 Pt
600 9.0 Mn	573 8.8 Bl	584 10.0 En	R CAM	568 12.3 Ch	602 8.8 Jo
602 9.0 Jo	T UMI	586 9.3 Sl	142584	587 11.2 L	603 9.0 Ko
602 9.0 Pc	133273	U UMI	566 11.3 Ch	597 9.5 Pt	611 9.7 Ko
603 9.0 Wd	509 11.3 BL	141567	602 12.7 Bg	610 8.9 L	613 9.5 Sf
609 9.2 Jo	512 11.6 BL	592 10.3 Jo	621 13.3 Br	S CRB	614 8.8 Jo
611 9.0 Ah	T CEN	593 10.7 Ah	R BOO	151731	615 9.5 Ah
613 9.0 Ma	*133633*	594 10.4 Jo	143227	567 11.6 Ch	616 10.0 Me
614 9.1 Me	556 7.8 Sl	597 10.5 Jo	567 10.7 Ch	576 11.0 Fd	619 9.7 Gy
614 9.7 Jo	557 7.9 En	597 10.6 Pt	593 9.1 Ah	590 9.7 Mn	621 9.6 Sf
615 9.4 Ah	558 7.7 Bl	602 10.7 Jo	597 8.9 Pt	593 9.2 Ko	628 9.8 Sf
618 9.7 Wd	561 7.7 En	602 10.9 Bg	597 8.5 Jo	593 9.0 Ah	U LIB
619 9.8 Mc	563 7.3 Sl	602 10.3 Pc	599 8.7 Ah	595 9.3 Ko	*153620a*
622 10.0 Mc	565 7.4 Bl	603 10.6 Sz	603 8.3 Jo	599 8.5 Ko	559[12.9 Bl
626 10.3 Mc	569 6.9 Sl	606 10.9 Hi	609 8.2 Jo	600 8.0 Mn	T NOR
U OCT	577 7.0 Bl	609 10.9 Jo	614 7.8 Jo	601 8.0 Pt	*153654*
131283	584 6.3 En	614 11.0 Jo	615 8.0 Ah	602 7.5 Pc	557 12.8 En
556 12.0 En	586 6.2 Sl	617 11.2 Hi	S LUP	603 7.9 Sf	561 12.8 En
558 11.9 Bl	599 6.4 Sl	S BOO	*144646a*	603 7.7 B	Z LIB
561 12.2 En	RT CEN	141954	557[12.1 En	613 7.0 Ko	*154020*
565 12.2 Bl	*134236*	567 8.8 Ch	569[12.1 Sl	613 7.2 Sz	559 13.2 Bl
568 12.0 En	557 12.0 En	567 8.8 We	U BOO	613 7.4 Sf	R CRB
573 12.5 Bl	557 11.7 Bl	584 9.0 We	144918	615 7.0 Ah	154428
V CVN	561 12.4 En	587 9.0 We	509 11.0 BL	621 7.2 Sf	541 6.0 Ch
131546	565 12.7 Bl	591 9.5 Th	512 10.9 BL	626 6.7 Pc	554 5.8 We
607 7.3 GD	R CVN	592 9.6 Jo	568 11.1 Ch	RS LIB	557 6.5 Je
619 7.3 GD	134440	594 9.7 Jo	Y LUP	*151822*	564 5.8 We
624 7.0 GD	509 9.8 BL	597 10.0 Jo	*145254*	557 11.1 En	564 5.8 Ch
626 7.0 GD	512 10.2 BL	597 9.9 Pt	557[13.7 En	558 11.3 Bl	568 5.8 Ch
R HYA	530 11.5 BL	598 10.0 We	558[13.7 Bl	561 11.5 En	587 6.0 Be
132422	567 11.8 Ch	602 10.3 Jo	S APS	565 11.4 Bl	587 6.0 L
539 9.5 Ch	597 12.0 Pt	609 10.4 Jo	*145971*	584 11.5 En	587 5.8 Mn
556 9.3 Sl	RX CEN	610 10.9 L	555 11.0 Bl	RU LIB	589 6.1 Oy
557 9.5 En	*134536*	614 10.6 Jo	557 11.5 Bl	*152714*	589 5.8 Ko
558 9.4 Bl	558[13.1 Bl	616 11.4 Bg	557 11.0 En	568[13.1 Ch	591 5.9 Ko
561 9.7 En	561[13.1 En	V BOO	558 11.5 Bl	R NOR	592 6.0 Ko
565 9.4 Bl		142539a	561 11.2 En	*152849*	593 6.1 Ch
569 9.4 Sl		567 8.7 Ch	563 11.2 Sl	557 12.8 En	593 5.8 Ko

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R CrB	R CrB	V CrB	SX Her	W CrB	W Her
154428	154428	154639	160325	161138	163137
593 6.1 Ah	618 6.0 HS	631 8.6 Hi	600 8.4 Ko	624 11.3 Pc	613 9.8 GC
594 6.0 Jo	618 6.1 Pt	R Lib	601 8.1 Pt	625 11.6 Md	614 9.5 Jo
594 6.0 Ko	618 6.0 Ad	*154715*	602 8.1 L	V Oph	615 9.8 GC
594 6.0 L	619 6.0 GD	568[13.0 Ch	606 8.4 Pt	*162112*	621 10.2 Sf
595 5.9 Ko	619 6.1 Pt	593 11.0 Ch	607 8.1 Pt	601 7.4 Pt	626 10.0 Pc
596 6.1 Ko	620 6.1 Wd	R Lup	613 8.2 Pt	610 7.6 L	R UMi
596 6.5 Je	621 6.1 HS	*154736*	613 8.1 Ko	U Her	163172
597 6.0 Ko	621 6.1 Mg	557[12.6 En	614 8.0 Pt	162119	592 9.0 Jo
597 6.1 Ad	621 6.1 Pt	569[12.6 Sl	616 8.1 Pt	588 11.7 Fd	594 9.4 Jo
597 6.1 Pt	622 6.1 Pt	RR Lib	617 8.5 Me	601 11.5 Pc	597 9.5 Jo
598 6.0 Jo	622 6.0 Mc	*155018*	618 8.0 Pt	601 11.6 Pt	602 9.6 Jo
598 6.0 Ko	623 6.1 Pt	601 8.5 Pt	619 8.0 Pt	603 11.5 B	610 9.3 L
598 5.8 We	624 6.1 Pc	610 8.7 L	619 8.4 Me	606 11.6 Hi	614 9.7 Jo
598 6.1 Pt	624 6.1 Wd	Z CrB	621 8.1 Pt	615 11.5 Hi	R Dra
599 6.1 Ah	624 6.1 Pt	155229	623 8.0 Pt	624 11.2 Pc	163266
599 6.0 Ko	625 6.0 Mg	602 14.5 L	624 8.1 Pt	SS Her	576 8.4 Fd
599 6.0 Jo	626 6.0 Mc	604[13.2 B	626 8.0 Pt	162807	587 8.0 Mn
600 6.2 Ko	626 6.2 Pt	RZ Sco	W Sco	593 9.7 GC	587 7.8 Ch
600 5.9 Mn	626 6.1 Pc	*155823*	*160519*	594 11.8 GC	591 8.4 Mn
601 6.1 Pc	627 5.9 Ad	557 10.6 En	559 12.4 Bl	597 11.2 GC	592 8.3 Jo
601 6.1 Pt	X CrB	561 10.0 En	RU Her	598 11.2 GC	592 8.6 Ah
602 6.0 Jo	154536	584 9.0 En	160625	601 10.6 Pt	593 8.7 Ah
602 6.0 Be	568 9.2 Ch	601 8.5 Pt	509 9.5 BL	610 9.4 L	594 8.4 Jo
602 6.0 L	601 9.5 Pt	Z Sco	588 11.7 Fd	613 9.3 GC	597 8.9 Jo
602 6.2 Pc	602 9.7 L	*160021*	594 11.7 GC	614 9.6 Sf	599 9.0 Ah
603 6.2 Ko	603 9.7 B	557 10.0 En	597 11.8 GC	621 8.9 Sf	600 8.7 Mn
603 6.0 Wd	606 9.8 Hi	559 9.7 Bl	598 11.7 GC	T Oph	601 8.6 Pt
604 6.1 Sh	612 10.0 Hi	561 9.9 En	601 11.8 Pt	*162815*	602 8.8 Jo
605 6.1 Ad	614 10.0 Sf	584 9.5 En	602 11.6 Pc	559 12.9 Bl	602 9.0 Pc
606 6.1 Pt	621 10.8 Sf	610 9.5 L	604 11.7 B	S Oph	603 9.4 Wd
607 6.1 Wd	624 10.5 Hi	R Her	613 12.0 GC	*162816*	607 9.3 Wd
607 6.2 Pt	631 10.7 Hi	160118	615 12.4 GC	559 13.0 Bl	607 9.1 Sh
607 6.0 Me	R Ser	603 13.0 B	626 12.1 Pc	W Her	611 9.7 Mn
609 6.0 Jo	154615	620 11.7 BL	R Sco	163137	611 9.3 Ma
609 6.5 Ko	567[13.2 Ch	626 10.8 Pc	*161122a*	587 8.7 Th	614 9.3 Jo
609 6.0 Sh	616 10.5 Hl	U Ser	557 10.6 En	589 8.8 Th	615 9.5 Wd
610 6.0 L	V CrB	160210	559 10.9 Bl	591 8.9 Th	615 9.4 Ah
610 6.0 Be	154639	576 10.8 Fd	561 11.1 En	592 8.4 Jo	618 10.3 Fd
612 6.2 Pc	509 10.3 BL	588 10.1 Fd	584 11.9 En	592 8.9 Ko	618 10.0 HS
612 6.0 Ad	586 6.8 Mp	592 9.2 We	601 11.7 Pt	593 9.7 GC	618 9.4 Wd
613 6.0 Me	591 8.1 Th	598 8.8 We	S Sco	594 9.6 GC	619 10.0 Gy
613 6.1 Sz	593 7.4 Ah	601 9.1 Pc	*161122b*	594 8.7 Jo	621 10.1 HS
613 5.8 Ko	595 7.3 Jo	601 9.2 Pt	559 13.4 Bl	595 8.6 Ko	624 10.1 Wd
613 6.0 Sh	598 7.5 Jo	604 9.3 Mu	584[12.2 En	597 8.7 Jo	624 10.0 Sh
613 6.1 Pt	599 7.0 Mp	615 9.1 Mu	W CrB	597 9.6 GC	631 10.4 Fd
614 6.0 Jo	601 6.9 Pt	616 9.0 Hl	161138	598 9.6 GC	S Dra
614 6.0 Be	602 7.5 Jo	623 9.0 Mu	588 10.4 Fd	598 9.1 Ko	164055
614 6.2 Pc	606 8.0 Hi	626 8.9 Pc	592 10.5 Jo	601 8.9 Pc	593 8.3 GC
614 6.2 Pt	612 8.1 Hi	X Sco	594 10.7 Jo	601 9.2 Pt	594 8.3 GC
614 6.0 Mg	615 7.6 Ah	*160221a*	597 10.8 Jo	602 9.3 Jo	597 8.3 GC
614 6.5 Je	615 7.5 Bw	559 12.8 Bl	601 10.9 Pc	603 9.1 B	598 8.3 GC
615 6.0 Wd	617 7.6 Me	SX Her	601 10.9 Pt	603 9.3 Sf	613 8.3 GC
615 6.1 Pt	618 7.7 Md	160325	602 11.1 B	608 9.6 Me	615 8.3 GC
615 6.1 Ah	619 8.0 Mc	590 8.1 Ko	602 10.9 Jo	609 9.2 Jo	RR Oph
615 5.9 Ad	620 8.5 BL	593 8.1 Ko	613 11.2 Sz	612 9.5 Hl	*164319*
616 6.1 Pt	624 8.5 Hi	595 8.2 Ko	614 10.9 Jo	613 9.7 Ma	557 10.5 En
617 6.1 Pt	625 7.6 Md	597 8.4 Pt	617 11.3 Me	613 9.6 Sf	561 10.6 En
617 5.9 HS	626 8.6 Mc	598 8.0 Pt	618 11.3 Md	613 9.5 Ko	584 11.4 En

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RR OPH	α HER	SV SCO	T HER	RV SGR	R SCT
164319	171014	*174135*	180531	*182133*	*184205*
601 12.5 Pt	590 3.6 Ko	558 11.4 En	594 13.5 Br	564 13.0 En	590 5.8 Mn
S HER	591 3.4 Ko	559 11.0 Bl	597 13.2 Al	SV HER	590 5.0 Bc
164715	592 3.6 Ko	564 11.6 En	601 13.2 Pt	182224	591 5.0 Bc
601 11.8 Pt	593 3.4 Ko	W PAV	602 13.1 Pc	578 11.8 Bw	592 5.0 Jo
602 11.9 Pc	594 3.5 Ko	*174162*	610 13.2 L	597 12.7 Al	593 5.4 Ch
604 11.8 B	595 3.5 Ko	558 11.4 En	613 12.9 GC	603 13.1 B	593 5.1 Sl
624 12.2 Pc	596 3.4 Ko	564 11.4 En	615 12.8 GC	624 13.0 Al	594 5.0 L
RS SCO	597 3.4 Ko	569 11.9 Sl	617 11.0 HS	T SER	594 5.5 Bc
164844	598 3.4 Ko	RS OPH	618 11.0 HS	182306	595 5.2 Jo
557 9.4 En	599 3.4 Ko	*174406*	624 11.4 Pc	557 11.2 Ch	597 5.5 Bc
564 10.0 En	600 3.4 Ko	601 11.0 Pt	624 11.3 Fd	576 11.4 Bw	597 5.1 Bf
584 10.6 En	603 3.4 Ko	U ARA	W DRA	601 12.3 Pt	597 5.5 Pt
RR SCO	606 3.4 Ko	*174551*	180565	SV DRA	598 5.5 Pt
165030a	609 3.4 Ko	558 10.1 En	601 10.1 Pt	183149	599 5.1 Sl
557 11.3 En	611 3.3 Ko	564 9.8 En	604 10.0 B	613 10.9 Ma	600 5.9 Mn
559 10.6 Bl	614 3.4 Ko	RT OPH	610 10.3 L	RZ HER	601 5.7 Pc
563 11.3 Sl	615 3.4 Ko	175111	X DRA	183225	601 5.4 Pt
564 11.3 En	Z OPH	576 12.7 Bw	180666	594[13.4 Br	602 5.5 Jo
569 11.5 Sl	171401	603[12.5 B	604 11.0 B	X OPH	602 5.5 Be
584 11.8 En	591 8.2 Th	624[13.4 Bw	RY OPH	183308	602 5.7 Pc
586 11.4 Sl	593 8.9 Ah	T DRA	181103	541 7.3 Ch	602 6.0 GD
SS OPH	595 8.4 Jo	175458a	557 7.6 Sl	565 7.3 Je	603 5.8 Wd
165202	598 8.5 Jo	593 12.4 GC	563 8.1 Sl	587 8.1 Mn	606 5.5 Pt
601 13.5 Pt	601 8.5 Pt	594 12.4 GC	569 8.9 Sl	592 8.0 Jo	607 5.4 Pt
615 12.5 Hi	602 9.0 Pc	597 12.4 GC	586 11.3 Sl	592 8.1 Ko	607 5.5 Bg
631 12.0 Hi	603 9.1 Wd	598 12.5 GC	593 12.3 Sl	594 8.0 Jo	608 5.5 Bg
RV HER	612 8.9 Hl	613 12.3 GC	593 10.8 Ah	596 8.2 Je	608 5.5 Me
165631	618 9.0 Wd	617 10.8 BL	599 12.8 Sl	596 8.5 Ko	610 5.7 Be
604 13.6 B	624 9.3 Wd	615 12.0 GC	601 12.0 Pt	597 7.8 Ad	610 5.4 L
613 13.8 GC	RS HER	UY DRA	W LYR	597 8.2 Jo	610 5.4 Bg
615 13.5 GC	171723	175458b	181136	600 8.4 Mn	611 5.5 Bg
RT SCO	576 11.1 Bw	617 10.7 BL	592 8.4 Jo	601 8.2 Pt	612 5.6 Bg
165636	592 11.3 Jo	RY HER	592 8.7 Ah	602 8.4 Jo	612 5.5 Bc
559[14.0 Bl	593 11.6 Ah	175519	593 8.8 Ah	603 8.3 B	613 5.8 Me
564[13.0 En	595 11.5 Jo	576 9.7 Bw	594 8.7 Jo	603 8.1 Ko	613 5.6 Pt
R OPH	597 11.7 Jo	586 9.2 Mp	597 8.8 Jo	605 7.9 Ad	614 5.8 Pt
170215	601 12.0 Pt	599 9.0 Mp	597 8.8 Al	610 8.3 L	614 5.7 Jo
597 10.6 Ad	601 11.6 B	601 9.0 Pt	599 8.8 Ah	614 8.5 Jo	614 5.7 Bg
RT HER	603 11.8 Jo	603 9.4 B	600 8.9 Sf	614 8.5 Je	614 5.8 Mg
170627	614 11.8 Bw	610 9.1 L	601 9.0 Pt	615 8.0 Ad	615 6.0 Ma
593 9.2 Ko	621 12.0 Bw	615 9.6 Bw	602 9.0 Jo	617 8.3 Me	615 5.7 Bg
596 9.3 Ko	624 12.0 Hi	615 9.3 Ma	603 9.0 Wd	618 8.1 Ad	615 6.0 Pt
601 9.2 Pt	627 12.2 Bw	616 9.8 Md	603 9.1 B	625 8.7 Al	615 5.9 Bc
601 9.2 B	631 12.0 Hi	624 9.8 Md	610 9.7 L	627 8.2 Ad	615 5.8 Wd
602 9.2 Pc	S OCT	V DRA	614 9.6 Jo	RY LYR	616 6.0 Pt
604 9.2 Hi	*172486*	175654	614 9.7 Sf	184134	616 5.7 Bg
612 9.5 Hi	556 10.3 En	586 10.6 Mp	614 9.5 Me	586[12.2 Mp	617 5.8 Bg
613 9.6 Ko	568 11.2 En	599 10.5 Mp	615 9.6 Wd	594[14.1 Br	617 5.9 Me
624 10.0 Hi	584 11.6 En	601 10.2 Pt	615 9.7 Ah	R SCT	618 5.9 Mg
631 10.5 Hi	RU OPH	610 9.7 L	620 10.2 Sf	*184205*	618 5.9 Pt
RW SCO	172809	616 9.5 Md	620 10.2 Wd	541 5.5 Ch	618 5.7 Bg
170833	509 9.6 BL	625 9.7 Md	623 10.7 GD	557 5.4 Sl	618 6.0 Wd
558[12.6 En	601 12.7 Pt	R PAV	624 10.6 Wd	563 5.3 Sl	619 6.0 GD
559[12.6 Bl	RU SCO	*180363*	624 10.5 Al	564 5.5 Ch	619 6.1 Pt
α HER	*173543*	558 10.4 En	RV SGR	569 5.3 Sl	619 6.1 Mc
171014	558 11.1 En	564 10.2 En	*182133*	576 5.6 Fd	621 6.1 Pt
589 3.4 Oy	559 11.2 Bl		558 12.4 En	586 5.2 Sl	621 5.9 Bg
589 3.5 Ko	564 11.0 En		559 12.8 Bl	589 5.2 Oy	622 5.8 Mc

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R SCT	ST SGR	RW SGR	RY SGR	U LYR	R CYG
184205	*185512a*	*190819a*	*191033*	191637	193449
623 6.0 Mg	594 9.0 L	603 10.1 Mg	555 9.5 Bl	602 8.5 Jo	626 7.4 Mc
623 6.2 Pt	R CRA	614 10.3 Bw	556 10.0 En	615 8.5 Jo	627 7.7 Ad
623 6.1 GD	*185537a*	TY AQL	557 9.2 En	624 9.1 Fd	RV AQL
624 6.8 Wd	559 13.0 Bl	*190907*	557 9.8 Ch	AF CYG	193509
624 6.2 Pt	586 12.8 Sl	572 11.2 Bw	557 10.0 Sl	192745	602 13.8 Pt
624 6.2 Bg	593 12.8 Sl	588 10.4 Fd	557 9.3 Bl	587 6.7 Ah	T PAV
625 6.1 Bg	T CRA	601 10.5 Pt	559 9.5 Bl	592 6.8 Ah	*193972*
626 6.3 Pt	*185537b*	601 10.5 Pc	561 9.2 En	593 6.8 Ah	558 11.7 En
626 6.2 Mc	559 13.0 Bl	615 10.9 Bw	565 9.7 Bl	599 7.2 Ah	564 12.0 En
626 6.6 Pc	586 13.0 Sl	626 10.9 Pc	568 9.6 En	611 7.4 Ah	RT CYG
RW LYR	593 12.8 Sl	S LYR	569 10.5 Sl	615 7.4 Ah	194048
184243	Z LYR	190925	570 10.7 En	TY CYG	541 7.2 Ch
594[14.2 Br	185634	594[13.8 Br	572 11.0 En	192928	564 8.5 Ch
NOV AQL	594 13.6 Br	X LYR	573 10.4 Bl	539 12.2 Ch	588 8.0 We
184300	601 13.6 Pt	190926	577 10.6 Bl	600 14.0 Br	593 9.6 Ch
541 11.0 Ch	603 13.4 B	601 8.9 Pt	586 10.6 Sl	RT AQL	593 10.4 Ah
557 11.1 Ch	RT LYR	RS LYR	593 10.5 Ch	193311	594 11.0 Jo
592 10.8 Jo	185737	190933a	594 10.5 L	541 8.2 Ch	597 10.7 Ad
601 11.6 Pt	594 14.1 Br	600 14.0 Br	598 11.3 Pt	593 10.2 Ah	602 9.5 Pt
602 10.8 Jo	V AQL	614 13.2 Bw	601 11.7 Pt	599 10.2 Mp	604 10.8 Wd
614 10.6 Jo	*185905*	621 13.0 Bw	602 10.9 L	601 10.1 Pc	605 10.7 Ad
614 11.5 Pt	590 7.8 Mn	627 12.7 Bw	614 12.0 Pt	601 10.1 Pt	615 11.0 Wd
615 10.6 Ma	600 7.6 Mn	RU LYR	616 11.9 Pt	613 10.5 Ma	618 11.4 Fd
623 11.7 Pt	R AQL	190941	617 11.8 Pt	618 10.7 B	619 11.3 Me
RX LYR	190108	600[14.0 Br	618 11.8 Pt	626 11.2 Pc	620 11.5 Wd
185032	541 11.0 Ch	615[12.9 Bg	623 11.8 Pt	R CYG	624 11.5 Al
594[14.5 Br	587 8.5 Ah	624[13.3 Pc	624 11.8 Pt	193449	TU CYG
615[13.4 Bg	587 8.5 Mn	U DRA	TY SGR	557 11.2 Ch	194348
R LYR	588 7.9 Fd	190967	*191124*	587 7.4 We	506 10.9 Ry
185243	593 8.2 Ah	557 9.6 Ch	558[12.2 En	591 7.8 Bc	513 10.2 Ry
589 4.2 Oy	599 7.9 Ah	576 9.2 Ch	S SGR	592 7.5 Jo	516 9.8 Ry
591 4.2 Ko	600 7.8 Mn	601 10.6 Pt	*191319a*	592 8.5 Ah	519 9.4 Ry
592 4.4 Ko	601 7.2 Pt	604 9.8 Sf	558[12.9 En	593 8.2 Ah	521 9.4 Ry
594 4.2 Ko	601 7.5 Pc	614 10.3 Sf	564[13.4 En	593 8.6 Ch	529 9.3 Ry
595 4.3 Ko	615 6.7 Ah	621 10.6 Sf	591[11.1 Bc	594 7.3 Jo	534 9.3 Ry
596 4.3 Ko	615 7.3 Ad	628 10.9 Sf	597[11.1 Ad	597 7.5 Jo	550 9.2 Ry
597 4.3 Ko	618 7.0 Ad	W AQL	599 11.1 Mu	597 8.6 Ad	557 9.0 Ch
598 4.4 Ko	618 6.4 B	*191007*	615 11.3 Mu	598 6.8 We	566 9.8 Ry
599 4.3 Ko	626 6.6 Pc	572 13.5 Bw	615 11.2 Wd	599 8.1 Ah	570 9.8 Ry
603 4.2 Ko	627 6.7 Ad	615 10.9 Bw	624 11.1 Mu	602 7.5 Jo	576 10.2 Ry
606 4.0 Ko	V LYR	T SGR	626 11.5 Wd	602 8.0 Pt	576 10.2 Ch
607 4.2 Ko	190529a	*191017*	Z SGR	604 7.0 Wd	581 10.4 Ry
609 4.1 Ko	601 10.8 Pt	601 12.5 Pt	*191321*	605 8.3 Ad	588 11.1 Ry
611 4.2 Ko	618 11.6 Md	626 11.5 Pc	558 11.9 En	611 7.0 Ma	592 11.4 Ry
613 4.1 Ko	625 11.9 Md	R SGR	587 9.6 Mp	611 7.3 Ah	595 11.6 Ry
S CRA	RX SGR	*191019*	SW SGR	613 7.2 Me	599 11.7 Ry
185437a	*190818*	558 11.7 En	*191331*	615 8.0 Ad	602 11.1 Pt
557 11.9 Sl	558[12.4 En	564 12.1 En	558[12.1 En	615 7.6 Ah	606 12.1 Ry
558 12.4 En	594[13.1 L	591 10.5 Bc	TZ CYG	615 8.0 Wd	611 12.3 Ry
559 11.5 Bl	603[12.7 Mg	597 10.3 Ad	191350	615 7.6 Jo	X AQL
563 12.1 Sl	628[13.1 Bw	601 12.3 Pt	601 10.6 Pt	618 7.9 Ad	194604
564 12.0 En	RW SGR	615 10.6 Wd	U LYR	618 6.7 Fd	557 12.4 Ch
569 11.9 Sl	*190819a*	618 11.0 Wd	191637	619 7.0 Mc	591 8.7 Th
586 12.0 Sl	558 10.8 En	624 11.1 Ad	592 8.7 Jo	619 7.1 Gy	592 8.8 Jo
593 12.3 Sl	564 10.7 En	626 10.2 Pc	594 8.7 Jo	620 8.4 Wd	598 8.8 Jo
	594 10.0 L		597 8.6 Jo	624 7.8 Ad	600 9.2 Sf
	601 10.2 Pt		601 8.4 Pt	624 7.4 Al	601 9.3 Pc

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1931.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

X AQL
194604
602 8.7 Jo
602 8.9 Pt
604 8.9 Hi
612 9.1 Hi
613 9.0 Sf
614 8.3 Jo
618 9.2 B
619 9.8 Mc
621 9.2 Sf
622 10.0 Mc
624 9.4 Hi
626 10.1 Mc
626 9.5 Pc
628 9.4 Sf
631 9.4 Hi

χ CYG
194632
534 8.8 Ch
557 8.5 Ch
576 5.6 Ch
587 5.2 Ah
592 4.8 Ah
592 5.0 Jo
593 4.9 Ah
595 4.4 Jo
596 4.8 Ch
597 4.5 Jo
597 4.9 Ad
599 4.7 Ah
602 4.5 Jo
602 4.7 Pt
602 4.6 Bg
604 4.8 Bg
604 5.1 Wd
605 5.0 Ad
607 5.1 Sh
607 5.1 Wd
607 4.7 Bg
608 4.9 Bg
608 4.9 Me
610 4.8 Bg
611 4.9 Bg
611 4.9 Ah
612 5.0 Bg
612 5.1 Je
613 4.8 Me
613 4.7 Ma
614 5.0 Bg
615 5.1 Bg
615 5.1 Ad
615 5.1 Ah
615 4.7 Jo
616 5.5 Sh
616 5.1 Me
616 5.1 Bg
617 5.1 Bg

χ CYG
194632
617 5.1 Me
618 5.1 Ad
618 5.3 Bg
619 5.3 Gy
620 5.4 Wd
621 5.4 Bg
624 5.3 Bg
624 5.7 Wd
625 5.3 Bg
627 5.4 Ad

S PAV
194659
558 7.7 En
564 7.5 En

RR SGR
194929
559 12.4 En
564 12.2 En

RU SGR
195142
558 7.4 En
564 7.9 En

RS AQL
195308
564 9.0 Ch
618 10.7 B

NOV CYG
195553
567[13.2 Ch
624[12.2 Pt

RR TEL
195656
558[12.6 En

Z CYG
195849
564 11.0 Ch
587 9.0 Mp
601 8.6 Mp
602 8.8 Pt
616 8.5 Me

S TEL
195855
559 13.0 En

SY AQL
200212
588 12.4 Fd
602 12.9 Pt
620 9.4 Md

S CYG
200357
600 13.2 Br
602 13.0 Pt

R CAP
200514
601 10.8 Pc
602 10.2 Pt
624 11.0 Pc

S AQL
200715a
557 9.4 Ch
592 10.0 Jo
595 9.9 Jo
597 10.3 Jo
602 10.5 Jo
602 9.7 Pt
602 9.8 Bg
607 9.9 Bg
608 10.0 Bg
608 10.1 Me
613 10.4 Me
615 10.4 Bg
616 10.4 Bg
617 10.4 Bg
618 10.5 Bg
624 10.6 Bg
625 10.6 Bg

RW AQL
200715b
592 10.0 Jo
595 9.6 Jo
597 9.3 Jo
602 9.1 Jo
602 9.3 Pt
602 9.3 Bg
607 9.3 Bg
608 9.2 Bg
608 9.4 Me
614 9.2 Bg
615 9.2 Bg
616 9.1 Bg
617 9.2 Bg
618 9.2 Bg
624 9.2 Bg
625 9.1 Bg

R TEL
200747
565 10.0 En

RU AQL
200812
613[12.3 Ma

W CAP
200822
602 12.5 Pt

Z AQL
200906
576 12.0 Bw
587 13.0 Mp
602 13.0 Pt
614 11.8 Bw
616 11.8 Bg
621 11.1 Bw
625 11.1 Bg
628 10.8 Bw

R SGE
200916
592 10.8 Jo

R SGE
200916
595 10.1 Jo
597 10.2 Jo
602 10.0 Jo

RS CYG
200938
534 8.3 Ch
554 9.0 Ch
562 8.9 Ch
576 8.9 Ch
592 7.6 Jo
593 9.0 Ch
595 8.2 Jo
597 8.3 Jo
597 7.5 Ad
602 8.3 Pt
604 8.7 Wd
605 7.4 Ad
607 8.6 Ah
607 8.7 Wd
612 8.2 Je
615 8.7 Wd
615 8.0 Jo
617 8.6 HS
618 7.2 Ad
618 8.3 HS
620 8.7 Wd
624 8.7 Wd
624 8.4 Sh
624 8.0 Al
624 7.3 Ad

R DEL
201008
591 9.7 Th
593 11.4 Ko
593 11.3 Ah
598 11.4 Jo
614 9.8 Pt
615 10.3 Ah
615 9.9 Bg
615 10.1 Sf
621 9.7 Sf
627 9.2 Ie
628 9.2 Sf

RT CAP
201121
614 6.6 Pt

SX CYG
201130
534 12.6 Ch
578[13.1 Bw
628[13.1 Bw

RT SGR
201139
565 9.0 En

WX CYG
201437b
534 9.8 Ch

WX CYG
201437b
541 10.0 Ch
562 10.5 Ch
592 10.5 Ch
592 11.0 Jo
595 10.9 Jo
597 10.8 Jo
602 10.5 Bg
607 10.6 Bg
614 11.2 Pt
615 10.8 Jo
615 10.5 Bg
620 11.8 Md
624 11.3 Al
625 10.8 Bg

V SGE
201520
616 11.9 Bg

U CYG
201647
562 11.1 Ch
587 10.3 Mn
592 8.8 Jo
595 9.4 Jo
597 9.7 Jo
602 9.3 Pt
604 10.4 Mu
604 9.2 Wd
613 8.6 Me
615 8.6 Bg
615 9.9 Mu
615 9.0 Wd
615 9.8 Jo
618 9.8 Md
620 9.2 Wd
622 9.8 Sf
624 9.4 Fd
624 9.8 Mu
624 9.8 Al
626 10.4 Mc
628 9.8 Sf

RW CYG
202539
608 8.1 Me

RU CAP
202622
565[12.0 En

Z DEL
202817
602 13.8 Pt

ST CYG
202954
567 12.4 Ch
602 12.3 L
602 12.7 Pt

V VUL
203226

R MIC
203429
565 11.4 En

Y DEL
203611
613[12.5 Ma

S DEL
203816
602 12.2 Pt
615 10.9 Bg
618 11.3 Md

V CYG
203847
562 13.0 Ch
613 11.8 Ma
614 12.0 Pt

Y AQR
203905
592 11.7 Jo
594 12.0 Jo
602 13.1 Pt
624 12.5 Pc

T DEL
204016
631 13.6 Fd

V AQR
204102
602 8.2 Pt
618 8.2 Md
619 8.6 Me
625 8.2 Md

U CAP
204215
559 10.6 Bl
602 13.0 Pc
624 13.0 Pc

V DEL
204318
613[12.2 Ma

T AQR
204405
591 9.3 Mn
592 8.7 Jo
594 8.6 Jo
597 8.7 Jo
597 9.0 Ad
601 8.4 Mn
602 8.7 Jo
602 8.4 Pc
602 9.3 Pt
603 8.6 Mg
605 8.8 Ad
614 8.3 Jo
614 8.5 Me
615 8.6 Ad
615 8.6 Mn
618 8.5 Ad
624 8.3 Ad
624 8.1 Pc

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1931.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T AQR	Z CAP	RU CYG	U PSA	S LAC	V CAS
204405	*210516*	213753	*215628*	222439	230759
627 8.2 Ad	602 9.3 Pt	506 7.6 Ry	570[12.6 En	606 9.0 BL	602 11.5 Pt
RZ CYG	R EQU	513 7.8 Ry	U AQR	615 9.4 Bg	608 11.3 Bg
204846	210812	518 7.8 Ry	*215717*	617 10.0 BL	610 11.1 B
614 13.4 Pt	587 12.9 Mp	522 7.8 Ry	602 13.1 Pt	617 9.5 Me	619 11.3 Me
S IND	602 12.3 L	529 8.1 Ry	S PSA	618 9.5 Al	W PEG
204954	602 12.4 Pt	535 8.2 Ry	*215828*	620 9.9 BL	231425
565 9.4 En	621 14.2 Br	550 8.4 Ry	570 9.4 En	623 9.8 Md	592 9.5 Jo
X DEL	T CEP	566 8.8 Ry	RY PEG	627 10.0 BL	594 9.7 Jo
205017	210868	572 9.2 Ry	220133a	R IND	597 9.9 Jo
602 8.8 L	541 10.1 Ch	576 9.4 Ry	602 12.2 Pt	*222867*	602 9.6 L
602 9.2 Pt	564 9.8 Ch	578 8.8 Bw	615 12.4 Bg	570[12.0 En	603 10.0 Jo
613 8.7 Me	587 8.6 Mn	581 9.3 Ry	618 12.2 Bg	T TUC	614 10.4 Jo
616 9.2 Md	592 8.3 Jo	588 9.3 Ry	RZ PEG	*223462*	617 11.2 Al
624 8.8 Md	593 9.0 Ah	592 9.4 Ry	220133b	558 13.3 En	624 11.2 Al
RR CAP	595 8.5 Mn	593 9.8 Ah	602 12.0 L	565 12.9 En	S PEG
205627	597 8.0 Jo	599 10.1 Ah	602 11.6 Pt	570 12.9 En	231508
564 13.4 En	599 8.4 Ah	599 9.4 Ry	615 11.9 Bg	R LAC	602 12.9 L
T OCT	600 8.4 Mn	602 8.7 Pt	618 11.9 Bg	223841	602 12.8 Pt
205782	602 8.3 Pt	606 9.6 Ry	T PEG	602 12.2 L	618 12.8 B
586 9.0 Sl	604 8.3 Wd	614 9.7 Ry	220412	602 11.2 Pt	621 12.7 Br
R VUL	611 8.0 Ah	617 9.6 Me	601[12.8 Mp	RW PEG	V PHE
205923a	615 8.0 Ah	RV CYG	621[14.3 Br	225914	*232746*
567 11.3 Ch	615 8.1 Wd	213937	Y PEG	602 12.1 Pt	565[12.7 En
592 9.3 Jo	617 7.6 Me	602 6.3 Pt	220613	618 13.8 B	Z AND
592 9.2 Ah	618 7.9 Fd	RR PEG	621 13.7 Br	620 14.4 Ma	232848
593 9.1 Ah	618 7.9 Wd	214024	RS PEG	621 14.3 Br	602 10.9 Pt
595 9.0 Jo	619 8.2 Gy	576 9.7 Fd	220714	β PEG	608 10.5 Bg
597 8.8 Jo	625 7.8 Bg	602 11.2 Pt	602 9.5 L	225827	620 11.1 Md
599 8.8 Ah	RR AQR	618 12.7 Md	602 8.6 Pt	590 2.7 Ko	ST AND
602 8.9 Pt	*210903*	621 12.7 Br	623 10.5 Md	591 2.6 Ko	233335
608 8.8 Me	602 10.6 L	626 12.8 Md	R PSA	592 2.7 Ko	602 10.9 Pt
613 8.5 Me	602 10.6 Pt	631 12.8 Fd	*221230*	593 2.7 Ko	603 11.3 BL
615 8.7 Ah	633 11.6 Bw	μ CEP	570[12.0 En	594 2.7 Ko	606 11.0 BL
615 8.8 Bg	X PEG	214058	X AQR	595 2.6 Ko	609 10.5 Jo
616 8.5 Me	211614	591 4.2 Ko	*221321*	596 2.6 Ko	613 10.9 B
617 8.8 Me	602 10.3 L	592 4.0 Ko	568[12.4 En	597 2.6 Ko	615 10.8 Jo
V CAP	602 10.6 Pc	594 4.0 Ko	T GRU	598 2.5 Ko	617 11.2 Al
210124	602 10.3 Pt	595 4.0 Ko	*221938*	599 2.6 Ko	617 10.9 BL
568 8.6 En	614 11.6 Ma	596 4.0 Ko	559 11.2 En	603 2.5 Ko	620 11.2 BL
TW CYG	624 12.1 Pc	597 4.0 Ko	565 11.5 En	606 2.5 Ko	624 11.0 Al
210129	S MIC	598 3.9 Ko	S GRU	607 2.4 Ko	627 11.1 BL
567 11.4 Ch	*212030*	599 3.9 Ko	*221948*	609 2.5 Ko	R AQR
587 11.5 Mp	554 13.4 En	603 4.1 Ko	557 8.6 En	611 2.5 Ko	*233815*
601 12.4 Mp	570[13.4 En	606 3.9 Ko	559 8.4 En	613 2.5 Ko	568 8.5 En
602 12.3 L	W CYG	607 4.1 Ko	564 8.8 En	615 2.6 Ko	578 8.5 Jo
620 12.9 Md	213244	609 3.9 Ko	584 8.9 En	R PEG	597 8.5 Ad
621 12.9 Br	589 5.9 Oy	611 3.9 Ko	RV PEG	230110	602 8.3 Pt
X CAP	602 6.2 L	613 4.0 Ko	222129	593 8.8 Ah	603 8.6 Jo
210221	S CEP	R GRU	621[13.7 Br	600 9.0 Sf	611 8.6 Ma
565 11.7 En	213678	*214247*	S LAC	602 8.9 Pt	617 8.5 Me
X CEP	598 10.6 GC	557[12.9 En	222439	608 8.9 Bg	617 8.9 Al
210382	602 9.9 Pt	565[12.9 En	587 8.2 Th	615 9.5 Ah	618 9.0 We
621[14.6 Br	604 10.5 Md	V PEG	589 8.2 Ko	615 9.3 Sf	618 8.9 Ad
RS AQR	614 10.8 GC	215605	591 7.8 Th	619 9.4 Gy	627 8.9 Ad
210504	615 10.8 GC	602 12.1 Pt	595 8.7 Ko	621 9.4 Sf	Z CAS
602 14.1 Pt	616 10.5 Md	623 10.4 Md	602 8.9 L	628 9.4 Sf	233956
623 14.1 Mg	625 10.5 Md		602 9.3 Pt		603 14.4 Mg
626 13.3 Pc			603 8.8 Ko		605 13.8 L

Variable Star Observations Received During October, 1931.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
Z Cas	R Phe	R Cas	R Cas	Z Peg	Y Cas
233956	*235150*	235350	235350	235525	235855
606 13.6 Br	570 8.4 En	592 10.5 Jo	615 10.9 Jo	602 12.6 Pt	605 13.7 L
TX Cep	R Tuc	597 10.8 Jo	615 11.8 Wd	605 13.3 L	606 14.2 Br
234875	*235265*	600 10.3 Mn	615 11.4 Bg	621 13.2 Br	SV And
606 13.2 Br	558 9.9 En	603 11.5 Wd	615 10.5 Mn	W Cet	235939
RR Cas	565 10.4 En	604 10.8 Jo	621 12.2 Br	*235715*	602 13.3 Pt
235053	R Cas	610 11.1 B		597 7.6 Ad	621 13.0 Br
610[12.5 B	235350				
617[12.0 Al	587 10.1 Mn				

Rapidly Varying Irregular Variables.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.	Star	J.D.	Est.Obs.	J.D.	Est.Obs.
005840 RX Andromedae—					081473 Z Camelopardalis—				
	6594.8	13.5 Br	6613.7	11.3 Pt		6616.6	11.2 Me	6619 5	12.0 Me
	6595.5	12.7 Ry	6614.5	11.1 Ry		6616.7	10.8 Pt	6623.7	13.0 Pt
	6596.5	13.1 Ry	6614.7	11.6 Pt		6617.6	11.3 Bg	6624.5	12.6 Bg
	6597.8	13.0 Pt	6615.3	11.0 Ry		6617.6	11.4 Me	6624.7	12.5 Pt
	6598.6	12.8 Ry	6615.6	11.3 Bg		6618.6	11.7 Bg	6625.7	12.6 Bg
	6598.7	13.1 Pt	6615.7	11.1 Br		6618.7	11.5 Pt	6626.7	12.3 Pt
	6599.6	10.9 Ry	6616.6	11.7 Bg	202946 SZ Cygni—				
	6600.5	10.9 Ry	6616.7	11.5 Pt		6597.8	9.1 Pt	6614.7	8.9 Bg
	6601.7	11.5 Pt	6617.6	11.9 Bg		6598.7	9.0 Pt	6614.7	9.2 Pt
	6602.6	11.7 Bg	6617.7	11.5 Pt		6601.7	9.6 Pt	6616.7	9.2 Pt
	6603.4	12.0 Ry	6618.5	12.0 Bg		6602.7	9.6 Pt	6617.6	9.6 Me
	6603.8	11.9 Pt	6618.7	11.9 Pt		6603.8	9.3 Pt	6617.7	9.4 Pt
	6604.9	13.0 Pt	6621.8	13.5 Br		6604.9	9.1 Pt	6618.7	9.6 Pt
	6606.5	13.3 Ry	6623.0	13.3 Br		6606.7	9.2 Pt	6621.7	9.6 Pt
	6606.7	13.4 Br	6623.7	13.3 Pt		6607.7	9.4 Pt	6622.7	9.6 Pt
	6608.5	13.2 Ry	6624.6	13.6 Bg		6607.7	9.4 Bg	6623.7	9.5 Pt
	6608.9	13.0 Pt	6624.7	13.2 Pt		6608.9	9.0 Pt	6624.7	9.2 Pt
	6611.3	12.7 Ry	6626.7	13.5 Pt		6613.9	9.1 Pt	6626.7	8.9 Pt
060547 SS Aurigae—						6614.6	9.5 Me		
	6597.8	13.5 Pt	6608.9[	12.6 Pt	213843 SS Cygni—				
	6598.7[	12.6 Pt	6610.7	14.2 L		6554.1	11.9 Ch	6601.6	11.8 Pc
	6601.0[	13.9 Br	6621.9	13.8 Br		6562.1	11.9 Ch	6601.7	11.8 Pt
	6602.6	14.2 L	6623.0	11.3 Br		6576.1	11.8 Ch	6602.3	11.6 L
	6603.6	14.3 L	6624.7	11.7 Pc		6576.6	12.0 Fd	6602.6	11.8 Jo
	6604.9[	12.6 Pt	6624.7	11.8 Pt		6587.4	11.7 L	6602.6	12.0 L
	6606.7[	14.5 L	6626.7	12.6 Pt		6590.7	12.0 Bc	6602.6	11.9 Pc
	6606.9[	12.6 Pt	6627.7	13.5 Ie		6591.7	12.0 Bc	6602.6	12.1 Bg
	6607.0[	14.5 Br				6592.5	11.2 Ah	6602.6	11.7 Mg
074922 U Geminorum—						6592.6	11.7 Jo	6602.7	11.7 Pt
	6601.3[	11.4 Sl	6608.9[	12.4 Pt		6593.0	11.8 Ch	6602.8	12.0 Bc
	6602.7	14.1 L	6610.7[	13.7 L		6593.4	11.8 Ah	6603.5	11.8 Bf
	6603.7[	13.7 L	6622.0[	13.8 Br		6594.4	11.6 L	6603.6	11.7 Jo
	6604.9[	12.4 Pt	6623.0[	13.3 Br		6594.6	12.0 Jo	6603.6	11.6 Mg
	6605.3[	12.4 Sl	6626.8[	13.3 Pt		6594.8	11.9 Br	6603.7	11.8 L
	6606.9[	13.3 Pt	6627.7	14.2 Ma		6595.6	11.8 Jo	6603.8	11.7 Pt
	6607.0[	13.8 Br	6633.9	14.4 Ma		6595.7	11.8 Bc	6604.6	11.7 Jo
081473 Z Camelopardalis—						6597.6	12.0 Jo	6604.6	11.9 Wd
	6587.3	12.9 Be	6604.9	13.4 Pt		6597.7	11.8 Bf	6604.7	11.5 Md
	6587.3	12.8 L	6605.7	12.9 L		6597.7	12.0 Bc	6604.7	11.7 Mg
	6594.3	10.6 L	6606.9	13.5 Pt		6597.8	11.7 Pt	6604.9	11.7 Pt
	6598.7	11.9 Pt	6608.9	13.3 Pt		6598.5	11.8 Sf	6605.6	11.5 L
	6601.7	12.4 Pt	6610.3	13.0 L		6598.6	11.6 GC	6605.7	11.5 Mg
	6602.6	12.6 L	6610.6	13.1 L		6598.6	11.8 Jo	6606.6	11.4 Mg
	6602.6	13.1 Bg	6613.5	11.0 Me		6598.7	11.8 Pt	6606.7	11.5 Br
	6603.6	12.6 L	6614.6	11.0 Me		6599.3	12.0 Ah	6606.7	11.7 Pt
	6603.8	13.0 Pt	6616.5	11.0 Bg		6600.7	12.0 Br	6606.7	11.8 Ma

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1931.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.	Star	J.D.	Est.Obs.	J.D.	Est.Obs.
213843	SS CYGNI—				213843	SS CYGNI—			
	6607.6	11.8 Bg	6613.7	8.7 Pt		6617.5	8.6 Me	6621.6	8.6 Mg
	6607.7	11.7 Pt	6613.7	8.4 Ma		6617.5	8.3 C	6621.7	8.6 Br
	6607.7	11.4 Mg	6614.5	8.2 Sf		6617.5	8.2 Sf	6621.7	8.5 Pt
	6608.6	11.7 Me	6614.5	8.4 GC		6617.6	8.3 HS	6622.5	8.5 Sf
	6608.6	11.7 Bg	6614.5	8.4 Ma		6617.6	8.4 Bg	6622.6	8.6 Mg
	6608.6	11.4 Mg	6614.6	8.1 Mg		6617.7	8.5 Pt	6622.7	9.2 Pt
	6608.7	11.5 Br	6614.6	8.5 Jo		6617.7	8.5 Mg	6623.0	9.0 Br
	6608.9	11.6 Pt	6614.6	8.5 Bg		6617.9	8.6 Ma	6623.6	8.8 Mg
	6609.6	11.8 Jo	6614.7	8.4 Bc		6618.5	8.2 Sf	6623.6	9.2 Md
	6609.6	11.1 Mg	6614.7	8.7 Pt		6618.5	8.5 Wd	6623.7	9.3 Pt
	6610.3	10.7 L	6614.8	8.5 Ma		6618.6	8.4 Fd	6623.7	9.0 Me
	6610.6	10.4 L	6615.3	8.5 Ah		6618.6	8.5 Mg	6624.5	8.6 HS
	6610.6	10.8 Mg	6615.5	8.3 GC		6618.6	8.3 HS	6624.6	9.4 Md
	6610.7	10.2 Br	6615.5	8.2 Sf		6618.6	8.7 Bg	6624.6	9.1 Pc
	6611.5	9.3 Ah	6615.6	8.2 Mg		6618.6	8.7 Al	6624.7	9.5 Pt
	6611.6	9.7 Me	6615.6	8.4 Jo		6618.7	8.7 Pt	6624.7	9.4 Ma
	6611.6	9.7 Bg	6615.6	8.5 Wd		6618.7	8.3 We	6625.5	9.8 Sf
	6611.7	9.3 Ma	6615.7	8.3 Br		6618.7	8.7 Md	6625.6	9.8 Md
	6611.7	9.2 Mg	6615.7	8.5 We		6619.5	8.5 Me	6625.6	9.4 Al
	6612.6	8.8 Bg	6615.7	8.6 Bg		6619.5	8.2 Sf	6625.7	9.8 Bg
	6612.6	8.7 Mg	6615.7	8.6 Ma		6619.6	6.8 Mg	6625.8	9.5 Ma
	6612.7	8.7 We	6616.5	8.2 Sf		6620.6	8.5 Sf	6626.6	**10.3 Pc**
	6612.7	9.0 Bc	6616.5	8.7 Bg		6620.6	8.6 Wd	6626.7	10.5 Pt
	6613.5	8.3 Sf	6616.6	8.5 Mg		6620.7	8.7 Md	6626.7	**10.1 Md**
	6613.5	8.6 Me	6616.6	8.6 Me		6620.7	8.3 Br	6627.5	**10.6 Ie**
	6613.6	8.3 Mg	6616.7	8.7 Md		6620.7	8.6 Ma	6627.8	10.2 Ma
	6613.7	8.4 Bc	6616.7	8.8 Pt		6621.6	8.4 Sf	6628.5	10.7 Sf
								6631.5	12.0 Fd

SUMMARY FOR OCTOBER, 1931.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Ahnert	Ah	36	103	Jones	Jo	62	272
Aldwell	Ad	14	48	Kohman	Ko	14	133
Allen, P.R.	Al	19	24	Lacchini	L	92	123
Baldwin	Bl	53	102	MacQueen	Mu	3	9
Benini	Be	6	9	Marsh	Ma	47	68
Bigelow	Bw	19	38	McLeod	Mc	17	40
Boutell	BL	17	49	McPherson	Mp	13	18
Bouton	B	37	37	Meek	Me	35	56
Brocchi	Br	67	94	Mennella	Mn	20	45
Buckstaff,E.H.	Bf	2	3	Millard	Md	22	42
Buckstaff,R.N.	Bc	6	18	Monnig	Mg	8	32
Bunting	Bg	35	111	O'Byrne	Oy	6	6
Campbell	C	1	1	Peltier	Pt	199	338
Chandra	Ch	54	85	Proctor	Pc	46	73
Ensor	En	86	164	de Roy	Ry	7	97
Ford	Fd	30	37	Shinkfield	Sl	34	120
Georgetown	GC	8	36	Shultz	Sz	6	8
Godfrey Club	GD	4	9	Smith,F.W.	Sf	15	56
Gregory	Gy	12	12	Smith,L.	Sh	4	9
Haas	HS	5	12	Theile	Th	7	10
Hildom, A.	Hi	8	23	Webb	Wd	21	68
Hildom, L.	Hl	4	4	Wetherbee	We	8	18
Iedema	Ie	5	5				
Jansen	Je	4	8	Totals		46	403	2665

ANNUAL REPORT OF THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS FOR THE YEAR ENDING OCTOBER 31, 1931.

Observer	Initial	November	December	January	February	March	April	May-June	July-Aug.	September	October	Totals
Ahnert	Ah	178	144	160	129	108	396	199	157	83	103	1657
Aldwell	Ad	..	..	..	..	..	..	3	13	24	48	88
Allen, P. R.	Al	10	10	8	6	7	26	9	3	23	24	126
Ancarani	An	..	..	..	..	..	..	8	26	..	..	34
Baldwin	Bl	41	54	144	176	67	99	116	174	133	102	1106
Benini	Be	8	..	..	..	..	..	18	67	37	9	139
Bigelow	Bw	18	21	15	16	34	33	52	5	..	38	232
Boutell	BL	67	48	59	73	32	34	95	..	..	49	457
Bouton	B	94	67	48	32	45	72	105	..	..	37	500
Brocchi	Br	28	9	20	..	105	36	..	82	198	94	572
Brown, A. N.	Bn	9	..	..	..	8	17	..	12	8	..	54
Buckstaff, R. N.	Bc	8	3	..	3	6	1	11	45	16	18	111
Bunting	Bg	5	12	4	29	21	45	66	80	135	111	508
Chandra	Ch	..	..	274	55	279	392	105	186	..	85	1376
Dartayet	Dr	..	308	..	126	97	122	150	..	..	..	803
Dawson	Dw	..	..	..	11	9	18	12	..	..	..	50
Ensor	En	136	105	88	90	51	98	240	284	119	164	1375
Ferris	Fe	9	8	8	..	..	..	..	..	..	..	25
Ford	Fd	106	46	..	120	105	66	124	190	..	37	794
Georgetown Obs.	GC	..	..	..	..	..	..	22	..	..	36	58
Godfrey Club	GD	20	12	6	13	4	15	16	32	22	9	149
Gregory	Gy	26	21	24	..	26	15	48	11	32	12	215
Guiler	Gc	15	7	..	4	..	..	..	..	..	..	26
Haas	HS	10	..	..	..	..	15	..	37	..	12	74
Hildom, A.	Hi	..	..	..	..	..	..	..	13	38	23	74
Houghton	Ht	169	161	204	..	166	169	261	145	..	..	1275
Jansen	Je	..	..	..	..	..	..	..	24	..	8	32
Jones	Jo	242	..	383	145	123	136	349	465	204	272	2319
Kanda	Kd	98	..	..	40	..	29	..	58	..	..	225
Kline	Ke	..	..	..	28	39	34	58	..	..	..	159
Kohman	Ko	..	..	..	..	..	..	..	59	20	133	212
Lacchini	L	280	333	320	394	173	..	566	496	187	123	2872
Logan	Lg	..	16	..	..	..	..	..	8	8	..	32
MacPherson	Mp	..	..	..	8	12	7	13	18	10	18	86
Marsh	Ma	16	59	48	41	27	72	24	93	23	68	471
McLeod	Mc	32	12	17	12	..	55	42	128	62	40	400
Meek	Me	36	26	..	..	39	101	168	28	109	56	563
Mennella	Mn	..	..	..	..	..	..	8	66	45	45	164
Millard	Md	10	..	13	16	..	26	23	78	28	42	236
Monnig	Mg	40	26	14	22	20	17	56	53	91	32	371
O'Byrne	Oy	..	..	..	..	8	24	7	23	9	6	77
Peltier	Pt	310	319	252	240	214	239	425	435	310	338	3082
Proctor	Pc	..	..	28	40	8	74	44	11	61	73	339
Ross	Rs	10	10	7	23	..	..	9	..	..	..	59
de Roy	Ry	..	..	..	..	..	..	..	..	..	97	97
Shinkfield	Sl	..	29	91	47	..	121	88	125	37	120	658
Shultz	Sz	10	4	..	3	3	15	7	14	8	8	72
Smith, F. W.	Sf	19	31	30	38	27	39	33	30	30	56	333
Smith, W. H.	Sm	..	..	..	..	27	68	..	..	..	..	95
Taffara	Tf	49	40	..	40	15	5	11	..	..	..	160
Theile	Th	..	..	..	17	10	18	41	26	34	10	156
Vorhies	Vh	..	..	..	..	..	..	15	80	15	..	110
Wares	Ws	..	..	13	..	8	7	11	25	..	..	64
Webb	Wd	77	49	6	..	120	52	80	114	55	68	621

ANNUAL REPORT (Continued)

Observer	Initial	November	December	January	February	March	April	May-June	July-Aug.	September	October	Totals
Wetherbee	We	..	..	..	..	..	9	..	8	..	18	35
26 Others	..	35	6	16	..	..	53	14	62	85	30	301
Totals	81	2222	1996	2300	2037	2043	2870	3572	4089	2299	2665	26273

SUMMARY OF ANNUAL REPORTS, 1912-1931.

Year	Observations	Variables	Observers
1912	6,180	175	19
1913	12,914	200	20
1914	14,506	255	28
1915	14,724	282	29
1916	11,261	290	30
1917	15,788	332	43
1918	16,112	280	34
1919	8,710	352	53
1920	9,099	399	69
1921	15,513	386	77
1922	16,994	372	72
1923	17,745	441	68
1924	19,484	450	70
1925	23,375	439	68
1926	17,990	434	74
1927	17,600	470	75
1928	23,144	500	78
1929	27,218	510	61
1930	26,823	500	76
1931	26,273	500	81
	Total 341,353	535[1]	401[2]

[1] Approximate number of different variables observed.
[2] Approximate number of different observers.

of the Fall of Meteorites, and the Recorder summarized the work of the Association during the past year. Mr. W. R. Boyd, Jr., read a preliminary report on the Light Curve of SS Cygni. His plot covered the 35 years since the variable was discovered, and indicated 255 maxima as having been observed; with not a chance that even one maximum brighter than magnitude 10.0 has been missed, so completely has the variable been observed. Probably no other variable star has been so thoroughly observed over the same years as has SS Cygni. Mr. Odin Roberts commented at some length on observing sites for the 1932 solar eclipse, telling us where and where not to go to see the phenomenon.

In the evening Mr. David B. Pickering took us—via the projection lantern—on one of his astronomical fraternity trips, covering western America and Japanese observatories. Mr. Leland S. Barnes acted as reporter for the meeting and his account will appear in a forthcoming number of *Variable Comments*.

The annual summary for the year ending October 31 is a source of general satisfaction. More than 26,000 observations have been contributed by 81 observers. Nine foreign countries are represented in the list of observers and the 19 observers in these foreign countries contributed slightly ovr 12,000 observations; the re-

maining 14,000 being made by the American observers. Eight observers contributed more than 1,000 observations each, and the list is headed by L. C. Peltier of Delphos, Ohio, with G. B. Lacchini of Turin, Italy, a close second. E. H. Jones of Goffstown, New Hampshire, rose from seventh to third place. Although 16 observers contributed 75 per cent of the total number of observations, the remaining 25 per cent by 65 observers is worthy of commendation and of importance since they represent observations oftentimes secured at very opportune occasions.

LEON CAMPBELL, Recorder.

November 12, 1931.

METEOR NOTES

By CHARLES P. OLIVIER.

In writing these notes one of the purposes is to bring to the attention of observers unique observations which are made by experienced persons. This is done not only to put them on permanent record, but also in the hope that similar ones may be made when occasion offers.

Dr. Frank Schlesinger sent the following, made by Mr. J. S. Hall, Fellow in Astronomy: ". . . $0^h\,30^m$ A.M., E.S.T., June 4, 1931, my attention was attracted to an extremely brilliant meteor . . . I looked up in time to see it come to a sudden stop within $20° \pm 2°$ or 3° from Arcturus, in the line between Arcturus and the moon, having [come from] general direction of moon. It remained stationary for about 20^s, gradually decreasing in size but keeping the same lenticular shape. It was bluish green. . . At its maximum it was perhaps 15° long (in the direction toward Arcturus) by 5° wide."

This remarkable object was also observed at Leonia, New Jersey, by George Coble and O. B. Sloat, at 12:30 E.S.T. They gave its beginning point as at $\alpha = 19^h\,37^m$, $\delta = +17°\,18'$, ending point at $\alpha = 18^h\,34^m$, $\delta = +28°$, apparent size $= 15'$, head remained visible 5 sec, tail 30 sec, head white, tail golden yellow. It appeared with a sudden burst, and gradually died out, as did the tail. The latter trailed along entire course. After head disappeared, tail broke in middle, lower half drifting southward.

Thanks to these two observations the writer has calculated the end point of this fireball. It ended over $\lambda = 73°\,40'$, $\phi = +40°\,21'$ at 92.1 ± 6.7 km. Its path was practically vertical at Leonia, N. J., the object rising. An attempt was made to find the radiant using the celestial globe, but the two paths cut far below the horizon. As the New Haven direction of motion was admittedly uncertain, the observer not seeing the fireball at first, we may well assume that the radiant was practically at the horizon and the path horizontal. As the stratum from 75 to 95 km is that in which long enduring trains are found, this hypothesis fits well with theory.

Mr. J. H. Pruett (and Mrs. Pruett) of Eugene, Oregon, sends the following (much abridged): [July 12, 1931, $10^h \pm$ P.M.] . . . noticed a rather small meteor start from about altitude of 60° in N.E. and move quite slowly somewhat S. of E. . . . to its disappearance $20° \pm$ above the western horizon, 4 or 5 seconds elapsed . . . When about half way along its path, it suddenly began to brighten. The farther it went, the more luminous it became . . . A splendid trail remained to mark the last 15° to 20° of path. After watching this for 30 or 40 seconds and

noticing it persisted we decided to use the telescope. In finder, I was surprised at the sharpness and apparent double effect. In the 3-inch it was a splendid sight. Two ribbons of white light . . . It was no diffuse "comet tail" appearance. They were not straight but seemingly perfectly parallel and of uniform and equal width . . . The eyepiece gives 1° field. The double ribbon covered about 7′ or 8′ (in width, but in length crossed field).

"After a little while it could be seen that the ribbons were losing their distinct outlines and becoming wider. The dent in the upper part (shown in figure) became more pronounced . . . general color greenish . . . We watched the ribbons for 3 or 4 minutes, or until we could no longer distinguish them in instrument . . . for fully another minute the naked eye could detect the faint streak of light . . . (In) telescope the stars in field and ribbons of light were moving relatively . . . the trail was moving south among the stars (from later calculation). Perhaps this was due entirely to the apparent motion of the stars 20° above the western point of the horizon . . ."

This observation gives a good description of a splendid tubular meteor train. Due to the way it is seen, the edges should appear bright, and the intermediate portion fainter. Had someone elsewhere only made a duplicate observation, we might have calculated its approximate diameter and also the velocity of the wind at that altitude.

From O. E. Monnig, who with J. H. Logan was observing at Ft. Worth, Texas, on September 1, 1931, at 9:05 C.S.T.: ". . . I was observing the field of V Delphini, 204318, using an 11-inch reflector and 130± power. I saw a white 9^M meteor shoot across the field very rapidly . . . towards position angle 285° . . . Logan . . . at practically the same instant observed a white, first magnitude meteor moving very fast, the plotted path being from $\alpha = 19^h\ 10^m$, $\delta = +29°\ 45'$ to $\alpha = 17^h\ 46^m$, $\delta = +37°\ 20'$, . . . duration 0.2 sec.

"The remarkable part of the observation is that the direction of the meteor which I saw in the telescope agrees very well with the direction of the one Mr. Logan observed with the naked eye, and his plotted path, projected backwards, comes within 2½° of the field of V Delphini. But the point where he saw the meteor begin is over 20° from where I was looking with the telescope.

"Offhand it occurred to me that while it was entirely conceivable that these were two separate meteors it was more likely that they were identical. But if there was only one meteor, one is confronted with some almost unbelievable results as to height, length of path, and increase in brightness. The terrific speed of the object would indicate that it would have to be volatilized quickly, and argues against its being able to last over so long a path."

This Texas observation affords a unique possibility. The fact that Logan's projected path comes 2½° away from the point to which Monnig's telescope was pointing is no proof whatever that the object was not the same, because 2½° is well within the probable error of a person who is not a very constant meteor observer. The writer strongly inclines to the view that here we have the first recorded telescopic observation of the early stage of an eventually bright meteor. For it is well known that meteors must *begin* to glow, at least somewhat, before they, plus their gaseous envelope from which most of the light comes, can become visible to the eye. Also auroral observations show that there is some sort of atmosphere to a height of several hundred kilometers at least. But at such heights the gas cap has not formed to any appreciable extent, hence the meteor cannot be seen by the unaided eye. Monnig's and Logan's observation hence has the highest

theoretical importance.

THE LEONIDS. While it is much too early to give more than a brief notice to this shower, as few reports are yet in, nevertheless the writer will say something about his own observations. These were made with Mr. J. A. Kingsbury of the A.M.S., at his home, "Lavorika," in the Catskill Mts., New York, at an altitude of about 2000 feet. The night of November 13-14, in a partly clear sky, 14 meteors were seen by the writer in 2 hours, 6 being Leonids.

On November 16-17, at 11 hours the fog almost miraculously cleared, leaving a perfect sky. Besides Mr. Kingsbury and the writer, a party of 9 took part. These were Mrs. Kingsbury, Mr. and Mrs. Cecil Chichester, Mr. and Mrs. Konrad Cramer, Mr. and Mrs. Eugene Schleicher, Miss Heile, and Mr. Clarence McCarthy. These 9 observers counted the meteors in various quadrants and for various half-hour periods. From 11:00 to 17:40 the writer recorded 266 meteors, plotting about 100. The total counts were over 2500; allowing for duplicates at least 1000 Leonids were seen. The largest individual count was by Mrs. Chichester, who saw 485 in 4½ hours of actual observing. From 15 to 17 hours the rate was between 130 and 190 per hour for one observer. Two left 12 minute trains; several left trains for 5 minutes. All these changed their shapes rapidly. Very many meteors of magnitude 0 or brighter were seen. On the whole, the shower was an excellent one and gives much hope for a better next year.

TEXAS GROUP.

O. E. MONNIG, FT. WORTH OR BURLESON, TEXAS.

1931	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Remarks
April 5	8:00	8:46	46	4	1.0	5.2	5.2	4 more later
21	14:05	16:09	124	31	0.7	15.0	21.4	22 plotted
July 6	8:56	10:37	101	6	0.8	3.6	4.5	
11	10:04	11:45	80	13	1.0	9.8	9.8	
Aug. 6	9:08	10:35	87	13	0.9	9.0	10.0	
8	10:55	11:55	60	16	1.0	16.0	16.0	
9	10:28	11:32	64	11	0.8	10.3	12.9	
10	10:11	11:10	59	13	0.7	13.2	18.9	
11	10:19	11:40	81	30	1.0	22.2	22.2	21 plotted
Sept. 5	9:46	11:48	122	11	1.0	8.0	8.0	
16	8:10	10:05	115	11	0.8	5.7	7.1	

JOHN CONBOY, LAWTON, OKLAHOMA.

Aug. 11	10:00	13:30	210	60	1.0	17.1	17.1	Plotted

H. C. HOPPS, LAWTON, OKLAHOMA.

Aug. 11	10:00	13:30	210	153	1.0	43.7	43.7	46 plotted

MISS D. J. HAUSMAN, FT. WORTH, TEXAS.

Aug. 9	9:35	10:17	?	5				Plotted
10	9:54	10:43	?	8				Plotted
11	12:01	12:40	?	5				Plotted
12	10:36	11:34	?	7				Plotted

B. S. WHITNEY, NORMAN, OKLAHOMA.

Aug. 11	12:00	13:30	90	106	...	70.7	....	Count; 23 not Perseids

DR. A. M. REAGAN, DALLAS, TEXAS.

Aug. 11	10:15	10:45	30	6	...	12.0	....	Count
12	10:45	11:30	45	10	...	13.3	....	Count
12	14:15	14:45	30	18	...	36.0	....	Count
13	13:30	14:00	30	12	...	24.0	....	Count

O. C. Babbitt, Brownsville, Texas.

1931	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Remarks
Aug. 10	9:30	10:30	60	11	1.0	11.0	11.0	
12	11:30	11:50	20	22	0.6	66.0	[110.0]	
12	12:25	13:25	60	63	0.6	63.0	105.0	
13				Few	1.0			

E. Travers, San Antonio, Texas.

Aug. 11	7:45	11:30	?	10	0.9			
12	8:45	13:00	110	14	0.9	7.7	8.6	

Mrs. C. A. Roth and Mrs. C. M. Noble, Ft. Worth, Texas.

Aug. 9	9:30	12:30	180	19	...	6.3	....	12 Perseids
10	10:25	11:30	65	13	...	12.0	....	11 Perseids
10	13:50	15:00	70	55	...	47.1	....	49 Perseids

Miss Mary Ward, Ft. Worth, Texas.

Aug. 11	12:00	13:15	75	102	...	81.6	....	5 observers; 80 Perseids

Miss Frances Burns, Ft. Worth, Texas.

Aug. 10	9:45	11:00	75	49	...	39.2	....	4 observers

Harry Wear, Ft. Worth, Texas.

Aug. 11	12:00	14:00	120	154	...	77.0	....	5 observers

P. S. Watson, Baltimore, Maryland.

Aug. 15	14:00	15:15	75	26	...	20.8	....	3 observers: 22 Perseids

1931 Nov. 20, Flower Observatory, Upper Darby, Pennsylvania.

Meteors in the Field Museum, Chicago

The Field Museum of Natural History has an interesting display of meteorites. The largest and most interesting being the Quinn Canyon Meteorite found in Nevada in 1908.

Upon carefully observing this meteorite which is frustum shape, it is seen that the sides of this frustum resemble the surface of a fracture, and that the base of this frustum is convex, which indicates that this meteorite is a part of a much larger mass which was spherical, and that the convex base of this frustum-shaped meteorite was a part of the surface of the larger mass before it burst. I estimate the size of this spherical mass as being approximately 7 feet in diameter and weighing about 50,000 pounds.

In the sketch (Figure 1) 1-2-3-4-5 shows the outline of the meteorite and 1-2-3-8-7-6 is the outline of the original large spherical meteor before it burst. The base of this frustum shaped meteorite is the convex surface 1-2-3. (It is mounted upside down for better view). This convex surface 1-2-3 shows evidence of having been subject to great heat, it being a part of the surface of the large spherical meteor when it struck, while the sides 3-4 and 5-1 were within the sphere and not then exposed. This large spherical meteor was solid and moving at possibly 30 miles per second, it had such great intertia that the reaction of the air struck it like the force of an enormous trip hammer and it was burst into fragments and widely scattered. The striking and bursting greatly reduced the velocity and intensity of heat generated was less. So the convex surface 1-2-3 of the frustum, which was outside, shows signs of being burnt when heat was greatest. Had the meteorite been of its present shape when it struck the air it would have rotated and all sides burnt. Only in an exceedingly rare coincidence with center of

gravity exactly in front of center of resistance could it pass through air without being rotated. It would also be a rare coincidence that could break it into that shape before striking the air.

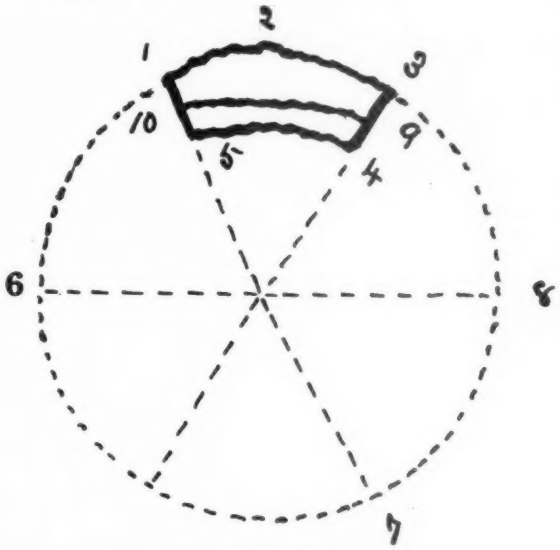

FIGURE 1.

Nearly all large meteorites are similar shaped and the base of frustum convex. The curve 1-2-3 in sketch and a curve at right angles to it passing through 2 are different, the latter arc being of a smaller circle—which indicates the large original meteor was not a perfect sphere, but flattened, more or less watch shaped. This same peculiarity is noticeable in all the large frustum-shaped meteorites I have seen.

While the large meteors before they burst appear to have conformed to a more or less regular shape a flattened sphere or watch shape, there were evidently inequalities in this outline. The slightest rotation or uneven motion of its parts when in its original molten state would tend to change its regular shape, or the slightest amount of gas in the interior while melted would account for the holes and inner cavities of the meteorites.

J. T. WATTS.

P. O. Box 15, Oak Park, Illinois.

The 1931 Leonid Meteors

Our first observations were made on November 8 (noon to noon reckoning), by Professor L. D. Hampton of Alabama Polytechnic Institute, Auburn, Alabama. On November 12, counts were made at Iowa City. On November 13 and November 14, counts were made at Auburn, Alabama. On each of these dates some meteors assumed to be Leonids were seen, Professor Hampton considering seven out of fifteen seen on November 14 to be Leonids. On November 13 and Novem-

ber 14, clouds and rain prevented observations at Iowa City and Dubuque, Iowa.

On November 15, the University of Iowa group carried out a program of plotting meteors from three stations, Amana, Tipton, and Mount Vernon, and maintained a count of the meteors until 15:15. A spectacular meteor, presumably a Leonid, crossed the sky from east to west covering a path fully 90 degrees in length at 11:07. It was seen by observers at the three stations. At Dubuque, Father J. A. Theobald of Columbia College supervised three groups each working two hours to cover the time from 12:00 to 18:00. Separate counts were maintained for the number of meteors seen by a group, the number seen by a single observer, and the number of meteors brighter than Jupiter which were seen. At Beloit College, Beloit, Wisconsin, Professor R. C. Huffer and a group of students kept a group count and plotted numerous meteors from 15:15 to 17:00. The results of the different counts show that the rate for one observer reached about 30 per hour, and for a group of seven to ten about 90 per hour. Clouds prevented observations at Auburn, Alabama, on this date.

On November 16, Professor Hampton at Auburn, Alabama, counted from a place with limited view. The southeastern sky was visible as high as the zenith. From 15:00 to 16:30 he counted 80 meteors, of which he considered 77 Leonids. At the beginning of his observations he was startled by the flash of light from a meteor which he did not see, and later he noticed the flashes from several other bright meteors outside his field of view. These flashes of light were not included in the count as meteors seen. It is reasonable to assume that with an unobstructed view his count would have been approximately the two per minute reached at Iowa City for the Leonids last year. At Beloit, Wisconsin, Professor Huffer and a group of eight students watched for half an hour. For a ten-minute period just after 14:00 the sky was partly clear although rather thick, and 11 meteors were counted. Clouds prevented observations at Iowa City and Dubuque on this date.

On November 17, at Dubuque, Father Theobald supervised groups and single observers working as on the fifteenth, but only for the period 14:45 to 18:00. At Iowa City, a count was maintained from 12:00 to 14:00 when clouds interfered, and with a partly clear sky from 15:20 to 16:00, when clouds again stopped observations. Clouds prevented any counts at Auburn on this date. The Dubuque counts for bright meteors and all meteors are both higher than for the 15th, and the bright meteors are most numerous before 15:00, becoming scarce in the period just before dawn. The Iowa City counts, although cloud interference makes them of less value, also indicate a higher number of meteors. Clouds and rain have prevented any observations at Iowa City since the 17th, and no different report has as yet been received from the other observers.

In interpreting these results, we might first call attention to the fact that the decrease in the number of bright meteors observed at Dubuque in the hours before dawn November 17 indicated that the maximum was past. The higher number for both all meteors and bright meteors on November 17 than on November 15 suggests that the maximum was nearer the observations of the latter date. In other words, persons living in longitudes farther west should, with clear weather, have seen a more spectacular display on November 16 than persons living in central United States.

A spectacular display occurred last year on November 16, and a similar display has been observed this year on the same date. Next year is leap year, and because of the extra day in February, such predictions must be thrown back three-fourths of a day. Our best chance for next year would therefore appear to be

November 15 or November 16 (the mornings of November16 and November 17 Civil Time).

Clipping from the Des Moines Tribune

Los Angeles (U.P.)—Hundreds of tiny Leonids literally turned night into day over the southern Nevada desert early Tuesday. The display of meteorites, which occurs every 33 years, was witnessed by scientists from Mount Wilson observatory, headed by Dr. Paul W. Merrill, during an airplane flight from Salt Lake City to Los Angeles.

C. C. Wylie.

University of Iowa, November 21, 1931.

Leonid Observations at Goodsell Observatory

Attempts to observe the Leonid meteors at Goodsell Observatory were not satisfactory. Cloudy weather prevented observations on all dates excepting Monday morning, November 16. In the interval from 1:00 to 5:00 A.M. only forty meteors were seen and of these only twenty were Leonids. E.A.F.

Northfield, Minnesota.

Meteors Observed

Perhaps some of your readers would be interested in the results from our astronomy class in the search for shooting stars in the recent maximum period. The weather was cloudy every night.

Date	No. per hour
Nov. 13	25
Nov. 14	25 (cloudy)
Nov. 15	36
Nov. 16	overcast

As these observations were all made in the hour 3:00-4:00 A.M. of the dates named, the ratio is nearly correct. Expectations that the night of November 14-15 would prove maximum were, as may be easily seen, well founded.

Janet G. Warren.

Maryville College, Maryville, Tennessee, November 19, 1931.

Bright Fireball.—At 10:00 P.M., C.S.T., October 17, I was standing in the yard observing the variables R Lyrae and α Cassiopiae, which I have been following closely for some months. I suddenly saw a fireball, the brightest I have ever seen, appear near ϵ Pegasi. Its brightness was equal to that of the full moon if not brighter. It lit up the landscape like a flash of lightning, and cast strong shadows. It was blue (not blue-white) in color. The diameter was about 25′. The motion was rapid. It disappeared in about a second, near the star λ Aquarii, leaving only a feeble train, reddish in color. Noah W. McLeod.

Christine, North Dakota, October 18, 1931.

COMET NOTES

By G. VAN BIESBROECK.

New Comet? A report of a circumpolar comet visible with the naked eye has been sent to A. C. D. Crommelin (*Circular* 106 *of the B.A.A.*); it came from Mr. J. W. Durrad of Leicester (England) and gave the rough positions:

1931 Nov. 6.84 U.T.	$11^h\,30^m$	$80°$
Nov. 7.84	11 0	70

The report does not seem to have received any confirmation. Visual and photographic exploration of the indicated region, undertaken at the Yerkes Observatory following a telegraphic request for confirmation from the Harvard Observatory, has not revealed the presence of a new comet. No further information has been received about it.

All the telescopic comets mentioned last month are still under observation but all are difficult objects.

In the evening sky COMET 1931 *b* (NAGATA) is now very difficult to observe on account of its faintness and its proximity to the sun. On December 8 it is in conjunction with the sun and passes then 28° north of it. After that date it will be gradually better seen in the morning sky. When last seen by the writer on November 17 it showed as a small round nebulosity about 30″ in diameter, with central condensation. The total brightness corresponded to a star of about 12^{M} but the observation being made at low altitude, that estimation is very uncertain. No further fluctuations of light such as were seen last month have been noticed. On November 17 the correction of Smiley's ephemeris given last month was +40^{s} and —0.4. From three observations made here on July 23, August 5, and August 31, F. E. Seagrave has deduced a new set of elements:

ELEMENTS OF COMET 1931 *b* (NAGATA).

Perihelion passage 1931 June 10.82183 U.T.

Node	191° 37′ 39.″2
Inclination	42 27 28.5
Longitude of perihelion	318 45 39.3
Perihelion distance	1.032123 A.U.
Eccentricity	0.934761
Semi-major axis	15.825 A.U.
Period	62.9261 years

These show a much longer period than was indicated by the preliminary orbit by the same computer. He gives the following ephemeris:

1931 0^{h} U.T.	α h m s	δ ° ′	Distance From Sun	Distance From Earth
Dec. 2	16 44 46	+5 35.9	....	....
6	51 37	42.3	2.72	3.55
10	16 58 20	5 50.4	....	....
14	17 4 55	6 0.2	2.80	3.62
18	11 22	11.7	....	....
22	17 40	24.8	2.89	3.69
26	23 50	39.6	....	....
30	17 29 51	+6 56.0	2.98	3.74

The increasing distance will, of course, reduce the brightness of the object. Yet there is a good chance that it will be followed for several months after its conjunction with the sun.

COMET 1931 *d* (PERIODIC NEUJMIN) remains under favorable observing conditions. It culminates near the zenith for northern observatories and can be observed all through the night since it is in opposition on November 26. However it appears as a little star as faint as 17^{M} and were it not for its motions there would be no way of distinguishing its stellar appearance from that of the surrounding stars.

COMET 1931 *c* (RYVES) has lost much more rapidly in brightness than was anticipated. When last observed here on November 18 it appeared as a large and very diffuse coma, nearly 5′ in diameter, with hardly any condensation toward the center so that the measures become quite uncertain. While the total brightness

was evaluated visually as $14^{M}.5$ on that night, a photograph with the 24-inch reflector shows only the densest part of the coma and this faint impression makes it hardly as bright as a 16^{M} star. The object will soon be too faint for further observations although the conditions of visibility improve.

COMET 1925 II (SCHWASSMANN-WACHMANN). The unique object, describing a nearly circular orbit located between those of Jupiter and Saturn, is now approaching its fifth opposition since its discovery in 1927. The following ephemeris by J. G. Behrens (*Beob. Zirk, der A.N.* No. 36) shows that it will be situated this winter in the constellation of Cancer:

EPHEMERIS OF COMET 1925 II.

	α	δ		α	δ
1931	h m	° ′	1932	h m	° ′
Dec. 5	8 22.1	+24 9	Feb. 15	7 53.7	+25 6
13	8 20.2	24 16	23	7 50.8	25 7
21	8 17.7	24 23	Mar. 2	7 48.6	25 5
29	8 14.8	24 31	10	7 46.9	25 1
1932			18	7 45.9	24 56
Jan. 6	8 11.5	24 39	26	7 45.5	24 50
14	8 7.8	24 47	Apr. 3	7 45.7	24 41
22	8 4.1	24 54	11	7 46.6	24 32
30	8 0.4	24 59	19	7 48.1	24 21
Feb. 7	7 56.9	25 4	27	7 50.2	24 8

While this object will very likely remain very faint we should not forget its unexpected outburst of activity last February when it rose from 16^{M} to 12^{M}, although its distance-relations from the sun as well as from the earth remained practically unchanged. This unusual object therefore deserves further attention.

Williams Bay, Wisconsin, November 23, 1931.

NOTES FROM AMATEURS

An Observational Aid.—It is apparent, in observations with the telescope, that if means are used to exclude reflections of external light, definition of detail becomes improved. To do this we consider various means. The simplest way is to use a dark colored cloth as a shade.

If we cut out of card board a circular disk, 10 to 15 inches in diameter, with a hole in its center, and with suitable devices attach it to the telescope, 7 or 8 inches from the eyepiece, in such a way that the telescope tube passes through the hole in the disk, we have a shade that is of use when viewing sun spots, and a material improvement when viewing the moon, particularly a bright full moon. Other forms to use in making the shade are a cone shape, as in a lamp shade, and again, as in a stereoscope.

Such shades are well adapted to views of the sun and moon when they are in positions above the horizon of not more than 30° to 45°. At greater angles, the shade would best be adapted to a diagonal eyepiece or an ocular prism. Lamp black, ground in Japan, and mixed with turpentine when used, makes a dull black covering for the shade; it dries quickly, and is without gloss, that would cause reflection of light.

S. E. FREW.

Port Clinton, Ohio.

Amateur Telescope Makers of Chicago

The November meeting of this organization was called to order at 2:00 P.M.

on Sunday, November 8, at the Adler Planetarium by President G. E. McCord, who then turned it over to A. J. Klapperich, the Astronomical Vice-chairman for November. He introduced as the first speaker F. C. W. Olson, who brought to our attention the most interesting features to be seen in the November sky. He was followed by W. L. Dennie, who under the topic "Star Maps," described the different types of Star Maps and Atlases and gave us an idea of the special information each was designed to convey.

A short business meeting, intermission, and Round Table broke the meeting into two distinct parts and gave every one a chance to take part. In the Round Table each one present who had brought in a mirror was given two minutes to tell of his work so far, and was then asked some questions by the others.

The honor of being the first Technical Chairman was given to President McCord, who introduced the speakers. Unfortunately sickness prevented some of them from attending, but the time was very profitably taken up by questions which were asked those who did speak. The first, A. J. Klapperich, described the different kinds of mirror materials, laying special emphasis on metal, and giving us the chemical compositions and characteristics of the different types of metals. He also mentioned the experiments which F. C. W. Olson is making on a new method of fusing the surface of "fused quartz" mirrors to remove the air-holes. Professor A. H. Carpenter, of Armour Institute of Technology, gave us a talk on methods of testing mirrors. He not only explained methods, but worked out the trigonometric formulas necessary. But his most convincing point was a 10-inch mirror that he has used for some time and had silvered for the occasion. It is of the Cassegrainian type and he brought the secondary mirror along as well as the testing set. This mirror will separate stars one minute of arc apart.

Anyone interested may write to President G. E. McCord, at 617 S. Kenilworth Avenue, Oak Park, Illinois, or phone Cedarcrest 0800.

A Plan for a Small Astronomical Museum

The astronomical museum in this country has received very little attention. However, in the July-August, 1926, number of *Natural History*, elaborate plans along this line were given by Butler for the American Museum. This wing when completed will run well up into hundreds of thousands of dollars. Professor Henry Norris Russell in the same number also gives a brief description of an astronomical museum. It is the scope of this paper to tell in what way the writer is building a small museum on astronomy to be used in connection with his observatory.

In the book, Manual for Small Museums, the statement is made that material on astronomy is limited. This is true in one sense of the word. Meteorites which are few in number are the only actual astronomical objects one can possess. Photographs and models, however, offer a larger field. The material may be divided into Meteorites, Photographs, and Models. Meteorites are rather difficult to get, however. They may be purchased from a dealer and often direct from the person on whose land they happened to fall. Some of my finest specimens have been purchased from farmers. All of the larger observatories have fine collections of astronomical photographs. The catalog of the Yerkes Observatory lists about fifty thousand.

The history of astronomy can be portrayed by the use of early engravings or illustrations taken from old astronomies or the loose plates of encyclopedias. These will show the planets, mythological figures, early telescopes, superstitions,

etc. The history may also be shown by a collection of early books on the subject.

Due to the development of the telescope the present day knowledge of astronomy shows a marked contrast to the above mentioned superstitions of early times. Some of the facts could be illustrated by the use of models. One might construct a fair-sized model showing the comparative size of the sun and its planets. The relative location and motion of the planets in the solar system could be shown by a model similar to the one on display in the Milwaukee Public Museum. The sun structure may be explained by a section on small scale showing the main body, the space between it and the photosphere, and the structure of a spot upon its surface. Another model of the sun with the spots in evidence would be an object of interest. The position of the sun, moon, and earth during an eclipse of the sun may be shown by models in their respective places. An oil painting and photographs of past eclipses would add greatly to this exhibit. Excellent pictures have been taken showing prominences and sun spots.

A globe of Mercury with the markings as observed by Lowell could be made. Photographs of its transits across the surface of the sun together with diagrams of its orbit and phases ought to be displayed with the model. Venus could also be shown by a globe with the markings upon it as they are portrayed in recent photographs of that planet. Pictures of the phases, relative sizes, and markings of the planet would add to the facts made obvious by the model.

Astronomers have made many globes of Mars showing its canals, oases, large blue green areas, polar caps, and other markings as revealed by the telescope. Any good map of the planet could be copied on to an ordinary globe, giving an excellent idea of our neighbor in space. Good photographs of Mars have been made at the Lowell Observatory showing the canals, clouds, polar caps, and also drawings showing frosts and snows. Copies of the older drawings of the planet would add to the historic value of the exhibit. A number of theories have been advanced regarding the canals. One is that these are tracts of irrigated land. An imaginary Martian landscape could be worked out in model form. Larger scale sections showing the polar caps and regions ought to be included with the material on Mars. The change in seasons as observed in a certain locality on the planet could be painted in colors on a series of small globes.

Jupiter, the giant of the solar system could be portrayed by a globe showing the cloud belts as they appeared on a certain date. Another model would illustrate the planet and its moons. Copies of early drawings as well as the modern photographs showing the transits and occultations of its moons and also the belts might accompany the exhibit.

Saturn, the marvel of the solar family is well adapted for model making. The body of this planet with its encircling ring system forms a picture which is unequaled anywhere in the heavens. Since the density of Saturn is .7 that of water a model of the planet in an ocean would make a very attractive display. The orbits of the nine moons of Saturn could be shown in miniature. Copies of the ancient and modern drawings together with the latest photographs ought to accompany this exhibit.

Observation of the light and dark spaces on the moon as seen with the unaided eye could be traced on a globe to show the appearance of our satellite. Plaster casts showing lunar craters and rills would be instructive and self-explanatory. A model would show the path of the moon around the earth. Both should be made on the same scale. Hundreds of photographs of our satellite have been taken at our observatories. A series of these pictures ought to form a part of the display.

Comparative sizes of other satellites of the solar system would be interesting. A series of six models illustrating Dr. George Darwin's theory of the formation of the moon from the earth would be instructive.

Meteors can be exhibited by means of photographs. Very excellent pictures of these may be purchased at the Yerkes Observatory. Actual meteorites can be collected or purchased for the museum and there are three classes of these objects. Those of stone, iron, and iron-stone. Sections of the different kinds showing the principal characteristics would add interest to the collection. Photographs of some of the larger meteorites and pictures showing where some of them had fallen, such as that of meteor crater of Canyon Diablo and the hole left by the Colby stone would be of value.

Some of the larger stars could be represented by small scale models showing our sun in comparison. Other interesting models would be one of the eclipsing variable Algol and that of a binary system. Photographs of some of the notable double stars like Mizar and Alcor could be shown in connection with this exhibit.

A three-inch sphere of the material in the strange companion of Sirius would equal the weight of a modern locomotive. A model to scale showing these comparisons could be worked out in interesting form.

Some of the stars that have colored companions like Beta Cygni could be represented by means of spheres, these to be painted the same shades as the stars themselves as in the case of these two which are yellow and blue.

A quadruple system such as Epsilon Lyrae could be worked out in model form.

The great star clouds and clusters have been photographed by the Yerkes Observatory and excellent transparencies of these could be purchased from that institution. The various kinds of nebulae are also recorded on the photographic plate and should form an important part of the display.

Another section of the museum could be devoted to a study of comets. Such a museum used in connection with an observatory would enable one to see in perspective some of the things seen through the telscope, as well as giving a clearer conception of the other objects. An astronomical museum could be incorporated in natural history departments of other institutions and would help to popularize this most fascinating science.

R. N. BUCKSTAFF.

Oshkosh, Wisconsin.

ZODIACAL LIGHT NOTES

By W. E. GLANVILLE.

GEGENSCHEIN. From Prof. Leah B. Allen, director of Williams Observatory, Hood College, Frederick, Maryland, a report with diagram has been received of an observation on October 13 at 10:30 P.M. slightly southwest of the Aries asterism, a roundish patch about 25° in diameter north and south. Eta Piscium, Gamma Pegasi, and Omega Piscium were just within the boundary. Professor Allen says that the apparition was very nearly on the limit of visibility. Miss Elisabeth Bryan, astronomy student, corroborated the observation quite closely. The writer observed the Gegenschein on October 20, November 1, 4, 7, 9, and 13. At 4:30 A.M. on October 20 it was extremely faint, elliptical in shape with ecliptic diameter possibly 20°; the center south of Eta Piscium. On November 1 at 8:20 P.M. it was seen southeast of Alpha Arietis with an east and west diameter of 15°.

It was connected with a zodiacal band between the Pleiades and the Hyades to the Milky Way. On November 4 from 9:50 to 10:15 P.M. in an exceedingly clear sky it was quite faint, elliptical, and appeared as a broadening of the zodiacal band. On November 7 at 4:15 A.M. it was easily seen, elliptical but somewhat roundish, center of figure near Delta Arietis. On November 9, 8:15 P.M., it appeared very diffuse just southwest of the Pleiades. On November 13, 8:30 P.M., it was in full view between the Pleiades and the Hyades, Delta Arietis being just within the western limit.

MORNING ZODIACAL LIGHT. Morning observations were made on October 20, November 7, 10, 11, 14, and 17. On October 20 the Light was strong at 4:30 A.M. It covered Denebola and Theta Leonis. At 4:45 these stars were clear of it as it shifted southwards. Upsilon Virginis was now about 5° inside the north boundary and Upsilon Leonis just inside the south boundary; the apex appeared to slope about 5° south of Regulus. At 4:55 the lower third of the Light spread rapidly as dawn came. Horizon breadth was estimated at 25°. On November 7, from 4:00 to 4:15, Upsilon Virginis and Upsilon Leonis indicated the north and south boundaries. The Light was fairly strong but could not be traced beyond Regulus, Jupiter being in the Sickle. On November 10, 4:50 to 5:15, the Light was exceedingly faint; in front of Leo it was columnar in shape, apparent breadth about 6°. At 5:15 it brightened considerably near the horizon and faded out entirely in front of Leo. On November 14, 4:45 A.M., in a perfectly clear sky the Light was strikingly brilliant from Gamma Virginis near the horizon to Regulus. Upsilon Virginis, on recent mornings within the north boundary, was now clear of it, while Upsilon Leonis, recently just within the south boundary, was now well within it. Thus the body of the Light showed a general southward shift as compared with observations of the previous week. On November 17, 3:15 A.M., no evidence of the Light could be detected; at 5:10 it showed faintly; atmosphere was hazy.

THE EVENING ZODIACAL LIGHT is becoming well placed for satisfactory observation. During December it will be seen in Capricornus and Aquarius.

A correspondent inquires if the northern luminosity in summer nights may not be auroral. While at Lick Observatory Dr. E. A. Fath made a special investigation of this matter in 1907 and 1908. He considered the possibility of that luminosity being auroral, or twilight, or Zodiacal Light. The result of his observations was the conviction that the luminosity is the Zodiacal Light. Concerning the aurora possibility he says: "Observations made with a spectroscope on several evenings showed the aurora line λ 5571 to be visible in all parts of the sky, and no brighter when the spectroscope was pointed to the maximum of the luminous area than when pointed many degrees away and entirely outside it. Observation shows that the maximum of the light moves with the sun." (*Publications of the Astronomical Society of the Pacific*, December, 1908.)

The Rectory, New Market, Maryland.

GENERAL NOTES

Professor Edwin Brant Frost, director of the Yerkes Observatory, is making a satisfactory recovery at the Billings Hospital, Chicago, from a recent illness. He expects to be able to return to his home early in December and to resume his accustomed duties at the Observatory at that time.

Dr. Otto Struve, who for a number of years has been a member of the staff of astronomers at the Yerkes Observatory, was appointed assistant director of the Yerkes Observatory by the action of the Board of Trustees of the University of Chicago on November 12.

Dr. Willem deSitter, of the Leiden Observatory, Holland, lectured at the Perkins Observatory, Delaware, Ohio, on Monday evening, November 23, on "The Size of the Universe." The lecture was the second of the series held on the affiliated program between the Observatory and the Graduate School of Ohio State University.

Dr. Harlan T. Stetson, Director of the Perkins Observatory and Professor of Astronomy at Ohio Wesleyan University, advises that invitations to collaborate in the final tests on the 69-inch mirror have been accepted by Dr. J. S. Plaskett, Director of the Dominion Astrophysical Observatory, and by the Bureau of Standards. The Bureau of Standards has designated Dr. I. C. Gardner, of the Optical division, to participate in the final tests.

The mirror has been finished at the factory of J. W. Fecker, Pittsburgh, and gives promise of extraordinary excellence, largely due to the painstaking annealing of the glass executed in the Optical department of the Bureau of Standards, Washington.

American Astronomical Society.—The forty-seventh meeting of the American Astronomical Society will be held in Washington, D. C., December 28-30, 1931. The superintendent and members of the staff of the United States Naval Observatory are in charge of the local arrangements. The sessions will be held in a room in the building of the Carnegie Institution of Washington. The Ambassador Hotel, 14th and K Streets, N. W., has been selected as hotel headquarters.

At the close of the sessions of the Society the American Section of the International Astronomical Union will hold a conference in preparation for the meeting which is to be held in Cambridge, Massachusetts, in September, 1932.

Amateur Astronomers Association.—Supplementary to the list of lectures announced in the November issue (p. 562) the following have been arranged for December and January: December 16, Dr. Clyde Fisher, "Mars, the Ruddy Wanderer of the Sky." January 6, Dr. Jan Schilt, "Star Counts." January 20, Mr. Stansbury Hagar, "Astronomical Temples of the Maya and the Mound Builders." All meetings at 8:15 P.M., in the large auditorium of the American Museum of Natural History, 77th Street and Central Park West, New York City.

The Observatory of the University of Michigan.—By recent action of the Regents of the University of Michigan, the name of the former Detroit Observatory has been changed to "The Observatory of the University of Michigan."

Between the years 1855 and 1870, the sum of $18,000 was contributed by citizens of Detroit to build and to purchase equipment for an observatory at Ann Arbor, to which the name Detroit Observatory was given. Brünnow was its first director, and Watson, one of Brünnow's students, later gave the young observatory an international fame.

The passing of three-quarters of a century has, however, made the original name neither accurate nor satisfactory. It was inaccurate because the buildings

and equipment which have since been added by the University or through gift, and even its annual budget, are very considerably greater than the original cost. The present observatory has now, moreover, branches in the Lamont-Hussey Observatory, at Bloemfontein, South Africa, and the McMath-Hulbert Observatory at Lake Angelus, Michigan. The tremendous growth of the city of Detroit, and of educational institutions in that city, has made the former name a source of confusion, so that considerable mail, both domestic and foreign, has been directed to Detroit rather than to Ann Arbor. For all these reasons, and in view of the plans to move the research work of the observatory to its new site fifteen miles northwest of Ann Arbor, the change in title has now been made.

The Edward C. Pickering Memorial Fund

Mr. Leon Campbell, who for many years has been Recording Secretary of the American Association of Variable Star Observers, and the chief Harvard Observatory representative in that Association, has been appointed Pickering Memorial Astronomer. With the assistance of a clerk he will have entire supervision of the observational work of the Association and discuss the data accumulated by its members.

Ten years ago it was proposed that the Association memorialize its founder, Professor Edward C. Pickering, by raising a fund to be known as the "Edward C. Pickering Memorial Fund." It was resolved that the income derived from this fund should be used to promote the study and observation of Variable Stars. Many friends of Professor Pickering in this country and abroad contributed to the fund. The Rockefeller Foundation and Harvard University made the most important contributions.

At a meeting of the Association held at the Harvard College Observatory on October 17, 1931, it was announced that the proposed fund had been completely subscribed and that the memorial has been officially established. The appointment of Mr. Campbell as Pickering Memorial Astronomer was made by the Observatory with the advice of the Council of the Association. In the list of officers of the Association Mr. Campbell retains the position of Recorder.

A room is to be equipped and set apart in the Harvard Observatory as headquarters of the Variable Star Association, and a bronze tablet suitably inscribed will attest the establishment of the Memorial.

The members of the Association and the many friends and colleagues of Professor Pickering have reason to be proud of their achievement. It is not only a fitting memorial to a distinguished astronomer, but it affords a greater opportunity of extending our knowledge of Variable Stars.

WILLIAM TYLER OLCOTT, *Chairman.*

Benjamin Franklin Memorial and The Franklin Institute

Rapid progress is being made on the new building in Philadelphia of the Benjamin Franklin Memorial and The Franklin Institute. This building will house the new Franklin Institute Museum, which will include in its astronomical section the Fels Planetarium, the second one outside of Europe. This will be a duplicate of the one in Chicago and various European cities. The department of astronomy will be in charge of James Stokley, Associate Director of the Museum.

The observing equipment will include a 20-inch reflector, which has been ordered from J. W. Fecker, of Pittsburgh; a 10-inch refractor, which has been ordered from Carl Zeiss, Jena; and a long focus coelostat telescope, to be placed on the roof, which will give a large image of the sun in the planetarium lobby,

also ordered from J. W. Fecker. The refractor is of the Urania type of mounting, similar to those in the Deutsches Museum at Munich, and the Urania Observatory at Zurich. In this type the eyepiece is placed close to the center of motion so as to facilitate its use by visitors. This instrument, together with the reflector, which will be of the Cassegrain type with an open fork mounting, will be placed on the top floor, covered by a sliding roof. In addition, exhibit space will be provided to display astronomical transparencies, models, and historic instruments. Among the latter will be the famous Rittenhouse Orrery, made by David Rittenhouse in 1769, which has been loaned by the University of Pennsylvania; the original telescope of Yale University, first used in 1830, and the heliometer and a Meridian Circle from the same institution, all loaned by the courtesy of Yale University. All of these instruments will be placed in the best condition before being displayed.

The entire building will ultimately form a square about 370 feet on a side and four stories high. It will front on Logan Circle, on the Parkway, being bounded by Twentieth Street, Twenty-first Street, Race Street, and Winter Street. Approximately forty per cent of the structure, including the entire east and north facades, will be built at present and it is expected to have this section completed by January 1, 1933. Probably the section containing the planetarium will be the first to open and will be ready several months before the rest of the building.

November 21, 1931. JAMES STOKLEY.

A New Sun-spot Coincidence

In examining the records of the West of Scotland Branch of the British Astronomical Association, the writer was struck by a curious coincidence. In the following table are set down the numbers of new members of the branch elected during each session since its foundation.

Session	Elections	Session	Elections	Session	Elections
1894-5	57	1905-6	51	1917-8	45
1895-6	3	1906-7	41	1918-9	39
1896-7	1	1907-8	26	1919-0	33
1897-8	10	1908-9	29	1920-1	33
1898-9	19	1909-0	33	1921-2	44
1899-0	21	1910-1	32	1922-3	28
1900-1	7	1911-2	31	1923-4	28
1901-2	0	1912-3	28	1924-5	30
1902-3	3	1913-4	37	1925-6	23
1903-4	8	1914-5	11	1926-7	17
1904-5	80	1915-6	12	1927-8	34
		1916-7	24		

It will at once be evident that these figures are in very precise agreement with the sun-spot cycle. This is brought out by the following table.

	Elections	Solar Activity	Difference (years)
Maximum	1894-5	1893	1
Minimum	1901-2	1901	0
Maximum	1904-5	1905	1
Minimum	1914-5	1913	1
Maximum	1917-8	1917	0
Minimum	1926-7	1923	3
Maximum(?)	1927-8	1928	1

The differences are counted from the former year of each session, because most elections naturally take place at the beginning of a session. The agreement is thus

to about one year; it will be noted that the last minimum for elections really began in the correct year 1923. It may be added that the short maximum of 1893, the long maximum of 1905, and the secondary maxima in the decline of activity after each maximum are all faithfully mirrored by the branch statistics.

The writer fears that it may be necessary at this stage to inform some ardent sun-spotters, who have not yet smelled a rat, that he does not believe there is any connection between the two series. Not only on logical grounds, but because there happen to be very good reasons for the fluctuations of the curve. The first maximum naturally coincides with the formation of the society; the second with the introduction of a cheap local membership; the next minimum is clearly due to the war; the following maximum to the end of the war period; then comes a minimum due to industrial depression, with a sudden jump, such as American societies must also have experienced, due to our Solar Eclipse.

If anyone cares to argue on more philosophical grounds, he is welcome; perhaps the activity of the sun is connected in astrology with human activity, for example the formation and expansion of societies; perhaps industrial depression is connected with sun-spots—I believe that has been held—and if so industrial depression has certainly an effect on our membership. I say, anyone is welcome to argue; but I do not wish to read the arguments.

The moral of this fable is—coinciding is not always a different word from coincidence. Probably every astronomer has met one or more people who would be none the worse of a few such examples as this.

Glasgow, Scotland, May, 1931. THOMAS L. MACDONALD, F.R.A.S.

Edisona.—In a note appearing in *A.N.*, No. 5832, Professor Fr. Kaiser states that he has assigned the name "Edisona" to asteroid No. 742, which was discovered by him in 1913. This is done, he says, in honor of the great American inventor, the late Thomas Alva Edison.

BOOK REVIEWS

The New Evolution, Zoogenesis, by Austin H. Clark of the U. S. National Museum. Pp. 297, 21 Chapters, 136 Illustrations, 15 Plates. (Baltimore, The Williams & Wilkins Co. 1930.)

All living things arise as the children of other living things called parents. Since this rule has no exception, it naturally follows that present life upon the earth is descendent from other life that flourished in ages past, and that in turn from yet earlier life, and so on back to the time when life first appeared on earth. Furthermore, every living thing begins life as a single undifferentiated cell. These two important facts lay a foundation for the very definite relationship existing between animal types.

Any given animal type is influenced not alone by its organic continuity with recent and remote ancestors, but also by its relationships with other types and with the environmental factors which furnish the setting in which the form has lived and developed. Animals and plants tend to occupy every habitable place on the earth, living in the water, on the land, and in the air. All habitats do not impose the same living requirements. All animals living on the land must seek food; while sea animals may swim and crawl in search of food, they may attach

themselves and let the motion of the water bring food to them, or they may simply float and drift about in the midst of their food supply. Three different ways of securing food instead of one means three times as many possibilities for major variations in the structure of the animals involved. Each large and distinct group of animals is characterized by certain adaptations which better fit its members to occupy a special niche or type of environment. It would follow that the number of large groupings in the animal kingdom (phyla) would not exceed the number of distinctive habitats to be found upon the earth; but that each phylum is an expression of relationships between the members of the phylum and the environment which is to be thought of as including such other forms as may be sharing the same habitat.

A comparison between geological processes of the present and the past would demand that the essential factors of the environment, *i.e.* air, water, soil, light, temperature, have remained unchanged. In other words, the conditions essential and necessary for the development of the different groups or phyla of animals which we know on the earth today have existed since life first began upon the earth. The possibilities are in favor of simultaneous development of some representative or representatives of all, or practically all, of the phyla or major groups of animals at the time of the very first appearance of life, *concurrent evolution.* The concurrent development of representative forms is designated as *cogenesis.* The various changes and vicissitudes which make up the history of animal life from the time of the appearance of these first representative forms down to the present time are the subject matter of *evolution.*

"The New Evolution" is easily readable and very well written and should interest the uninitiated as well as the Biologist. Mr. Clark's training and years of observation and research fit him admirably to write such a book. The work stresses a fine distinction in the use of the terms and pushes concurrent evolution in the distant past where it is safely out of reach. R.A.W.

Poems of Science, by William Pallister. (Playford Press, 11 West 42nd St., New York. $2.50.)

The author of this book embarks on a sea as yet sailed very infrequently. Recognizing the prominent place science has come to occupy in present day thought the author has regarded it as furnishing appropriate material for poetical treatment. It is fitting that this volume should be mentioned in an astronomical magazine, because much of the material in it is taken from that science. Of the seventeen illustrations ten are of astronomical subjects. This may be due to the fact that a star can more easily be photographed than an atom and for that reason may seem more concrete and more real. The book does not profess to be a textbook, and one who wishes to go deeply into any of the sciences would not be able to do so by means of this book alone. But the reader has the opportunity of getting an outline of the main points which are prominent in the minds of scientists today. And, moreover, the author points the way to a philosophical insight into the significance of science, and indicates ways in which it might be used for the benefit of humanity.

The plain facts of science often are cold and prosaic; but the implications and interpretations of them are inspiring. It is here that the element of poetry enters. This book can be recommended as informative, entertaining, and stimulating.